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# USSR Report

## ELECTRONICS AND ELECTRICAL ENGINEERING

## (FOUO 12/81)

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# USSR REPORT

## ELECTRONICS AND ELECTRICAL ENGINEERING

(FOUO 12/81)

CONTENTS

CERTAIN ASPECTS OF PHOTOGRAPHY,
MOTION PICTURES AND TELEVISION

UDC 621.397.61:621.397.132

EXPERIMENTAL THREE-MATRIX COLOR TELEVISION CAMERA USING CHARGE-COUPLED DEVICES WITH 580x532 ELEMENTS

Moscow TEKHNIKA KINO I TELEVIDENIYA in Russian No 6, Jun 81 pp 30-38

[Article by Ye. V. Kostyukov, A. N. Markov, N. K. Milenin, B. Ya. Nepomnyashchiy, Ye. A. Polonskiy and A. D. Tishchenko, All-Union Scientific Research Institute of Television and Radio Broadcasting]

[Text] Much progress has been made here and abroad recently in developing large-format matrices of charge-coupled devices (CCD), making it possible to use them for building models of all-semiconductor one-, two- and three-matrix color TV cameras [1, 4-8].

In the USSR we have developed both p- and n-channel large-format CCD matrices with frame transfer of charges and 580x532 elements [3]. These matrices are capable of operation at the 625-line standard and contain a storage section, memory section and output register (Figure 1) with three-phase electrode systems in the form of a three-layer, partly overlapped polysilicon structure in which the electrodes of a single phase match up with each layer of polysilicon, which makes it possible to improve the technological effectiveness of CCD fabrication [2, 3]. The area of the storage section is 9.5x12.8 mm, and that of the memory section 6.7x12.8 mm. The overall size of the crystal is 17.8x14.7 mm.

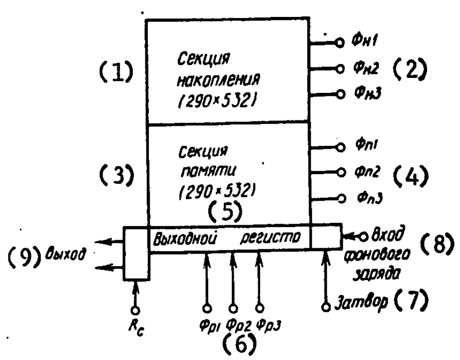


Figure 1. Diagram of Large-Format CCD Matrix With 580x532 Elements

Key:
1. Storage section
2. $F_{st}1, 2, 3$
3. Memory section
4. $F_{mem}1, 2, 3$
5. Output register
6. $F_{reg}1, 2, 3$
7. Shutter
8. Background charge input
9. Output

The image elements in the storage section measure 33x24 μm, in the memory section 24x24 μm, and in the output register 24x80 μm. Surface channels are used for charge transfer in the matrices. The CCD matrices which have been developed are assembled in a cermet case with 32 leads.

Saturation exposure with respect to light response amounts to about 0.03 lux•sec for the large-format matrices. The typical spectral response curve of the CCD matrices is shown in Figure 2. The sharp drop in the blue region of the spectrum is caused by the absorption of light in the polysilicon electrodes, the 0.5-μm thickness of which is in accordance with the specified value of their resistance. The rate of charge transfer from storage section to memory section is governed by the time constant of the RC electrode system. A high rate of charge transfer can lead to a darkening of the image in the center of the scanning pattern if the electrode system has bilateral power supply. Hence, RC is predetermined, and when $C=(12-16)10^3$pF the thickness of the electrodes, practically, can not be less than 0.5 μm.

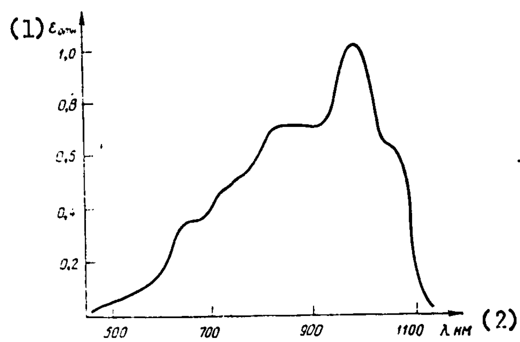


Figure 2. Spectral Response Curve of a 580x532-Element CCD Matrix

Key:
1. $\varepsilon_{relative}$
2. $\lambda$, nm

The inefficiency of charge transfer in the output register at an operating frequency of 10 MHz amounts to $\varepsilon = 6 \cdot 10^{-4}$, which leads to a difference of the frequency contrast characteristics (FCC) of the matrices at the left and right edges of the scanning pattern. On the left edge of the scanning pattern, where inefficiency of charge transfer can be ignored, a decline is observed in the FCC due to finite geometrical size of the elements, diffusion of charge carriers, an irregularity in the matrix output apparatus and so on (Figure 3).

The output apparatus of the large format CCD matrices has two outputs--primary and compensating. The output apparatus has a floating diffusion region in the primary channel and also integrated MOS-transistors for charge clearing, and integrated outflow repeaters in both the primary and compensating channels. The compensating channel is used for suppressing the interference from the operating pulses in the primary channel.

The functional diagram of a developed and fabricated experimental model color TV camera using three native large format matrices (with 580x532 elements) is shown in Figure 4. Signals from the output transistors of the matrices 5 are read by preamplifiers 9 and fed to the inputs of balancing amplifiers 10, in which occur video signal coupling, black level regulation, supplemental amplification and compensation of light diffusion. The amplified signal goes to regulated amplifiers 11, which effect operation of the white level automatic balance system; thereafter, the signals pass through gamma correction units 15, limiters and blanking circuits 16. In the R and B channels the signals are handled in a 1.5-MHz band whereas, in the G channel, including the balancing amplifiers, the full bandwidth--5 MHz--is

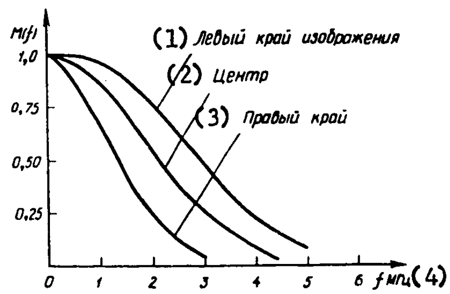


Figure 3. FCC of a CCD Large Format Matrix at an Operating Freqeuncy of 10 MHz

Key:
1. Left edge of image
2. Center
3. Right edge
4. f, MHz

maintained, and just ahead of the buffer amplifier 14 the signal goes through a low pass filter 12 with a pass band of 1.5 MHz. The G signal is used to form the high frequency part of the signal, and the aperture correction signal is also formed from it in aperture corrector 13. The high frequency part of the G signal and the aperture correction signal are added to the R, G and B low frequency signals in summing amplifiers 17.

A preamplifier schematic is shown in Figure 5. The purpose of the preamplifiers is amplification of the useful signal and suppression of switching interference. The CCD outputs are the outputs of FET's, one of them carrying a signal and switching noise and the other switching noise only. The signals from the matrix outputs proceed across decoupling repeaters VT1 and VT2 to the inputs of differential amplifier A1 which suppresses synphase switching noise. Amplifier A1 is an operational amplifier (200 V/μsec, amplification factor 3000). This amplifier is loaded on a fifth order Cauer low pass filter, from the output of which the signal proceeds across emitter repeater VT3 to the video processing board. To reduce stray currents the preamplifiers are enclosed in shields and positioned next to the CCD matrices. The output signal from the preamplifiers has an amplitude of 200-300 mV.

The balancing amplifiers (Figure 6) perform a number of functions including amplification and coupling of the signal to the black reference level. It is usually not possible to isolate information on the black level during a horizontal quenching pulse because of the differential reading of the signal from the CCD matrices and the dependence of the blanks' level on the control system for the matrices. Hence, coupling of the signal is performed at the black level derived from blacked out elements. Several elements on each line are covered up for the purpose. This method of coupling does have one defect however. Between the crystal face and the

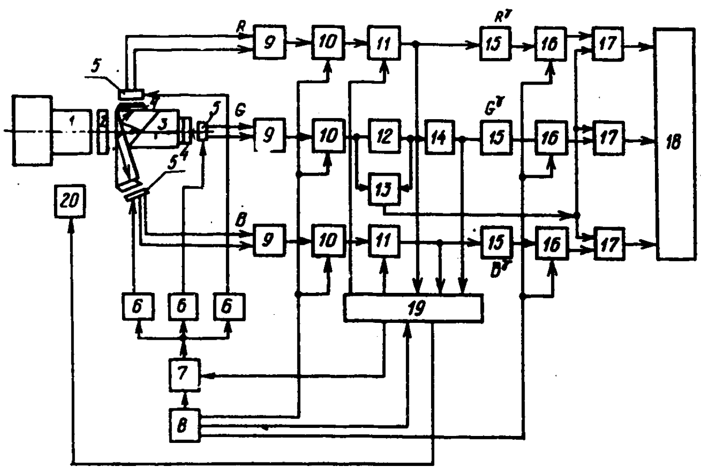

Figure 4. Functional Diagram of the Three-Matrix Color TV Camera

Key:

1. 350PF7-1A lens
2. Infrared filter
3. Color-separating prism
4. Neutral light filters
5. CCD large format matrices
6. Output pulse amplifiers-switches (drivers)
7. Apparatus for CCD matrix control
8. Master oscillator and synchronization system
9. Preamplifiers
10. Balancing amplifiers
11. Regulating amplifiers for automatic white balance system
12. Low pass filter
13. High frequency signal shaper and aperture corrector
14. Buffer amplifier
15. Gamma correction units
16. Limiters and blanking circuits
17. Summing amplifiers
18. Color monitor
19. Automatics systems
20. Diaphragm drive

protective glass of the matrix case is a gap through which light comes in part way under the darkening strip, leading to a distortion of the "black" level. An illumination compensating circuit is used to reduce these distortions. From here on it is proposed to apply a darkening coating directly to the CCD matrix crystal.

Besides coupling and amplifying, the balancing amplifiers also perform gain switching from field to field. The switching is necessary because the levels of the signals in adjacent fields are unequal. In the first field the signal buildup takes place at the electrodes of only the first phase, but in the second field it occurs simultaneously at the electrodes of the second and third phases.

The foundation of the balancing amplifier (Figure 6) is a broad band operational amplifier A1 in G channel; a 574UD1 can be used in R and B channels. Gain switching from field to field is done by a divider R2, R8 controlled by a switch on FET VT2, to which the field frequency pulses go. The coupling circuit is made from

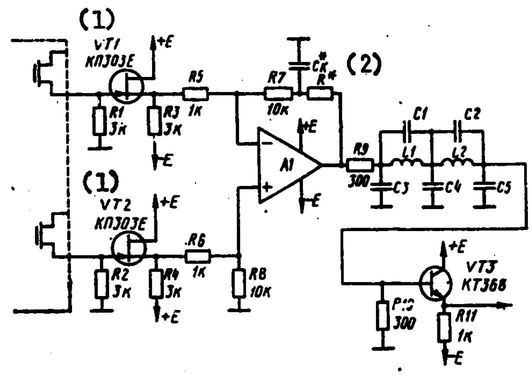


Figure 5. The Preamplifier Circuit

Key:
1. Part number at VT1 and VT2 is KP303Ye
2. Capacitive feedback, identified in text

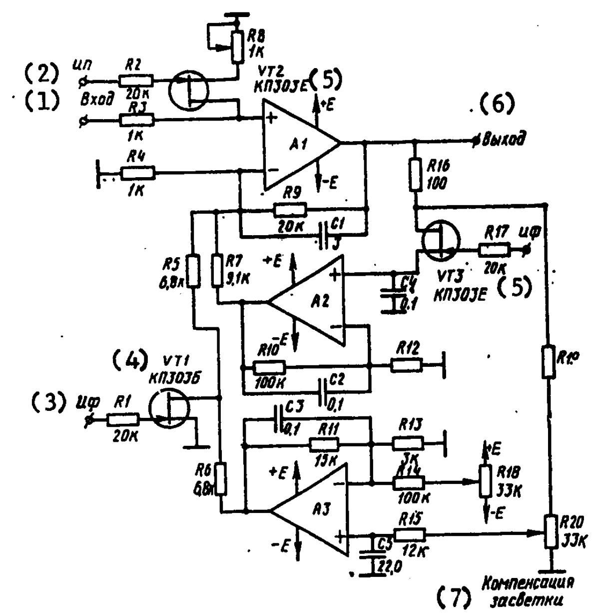


Figure 6. The Balancing Amplifier Circuit

Key:
1. Input
2. Field frequency pulses
3. Clamping pulses
4. KP303B
5. KP303Ye
6. Output
7. Illumination compensation

operational amplifier A2, a type 153UD6. A switch on FET VT3 is opened by a shifted clamping pulse at the beginning of an active line. The signal level corresponding to the black strip is stored at capacitor C4. This signal is compared with zero potential and amplified by operational amplifier A2. The amplified error signal goes to the inverting input of amplifier A1. The operational amplifier A3, a type 153UD6, performs the functions of illumination compensation and black level regulation. Regulation of the black level R18 is accomplished by means of a displacement applied to the inverting input, and the compensation signal is formed via integration at capacitor C5. The degree of compensation is regulated by resistor R20. Amplifier A3 produces an error signal which is applied to the input of amplifier A1, and FET VT1 cuts off the compensation signal for the time of the coupling operation.

Signals having an amplitude of 2 V and coupled to the black level from the balancing amplifier outputs go to amplifiers with a regulated amplification factor (Figure 7). The regulating element in the amplifiers is a 525PS1 four-square multiplier. The signal from collector loads R10, R11 is picked up by broadband operational amplifier A2 and then passed to the automatics system. This system compares R, G, and B signals and produces error signals. The error signals proceed across a divider R9, R12, inputting into a feedback circuit, to the amplifier's controlling input. Resistor R8 establishes the nominal gain and the range of automatic balance. At the circuit output the signal output is 5 V, which is ample for normal operation of the very simple gamma correction unit employing resistive dividers and diodes. The signal, processed by the gamma correction unit, proceeds across the black-and-white-levels-limiters circuit (Figure 4). The hybrid integrated circuit of the limiters provides white level limitation of 2 V, black level of 60 mV, and also performs the blanking operation. After these operations, the high frequency part of the signal and the aperture correction signal are introduced into the $R^{\gamma}$, $G^{\gamma}$ and $B^{\gamma}$ low frequency signals. The summing is performed in broadband operational amplifiers with powerful output stages.

The formation of the high frequency portion of the R, G and B signals and the aperture correction signal takes place in the aperture correction unit (Figure 8). The G signal (5 MHz band) goes to the input of this cascade from the output of the balancing amplifier. The broadband signal passes across a delay line and a low pass filter with a pass band of 1.5 MHz. The high frequency portion of the signal is formed by operational amplifier A1 as the difference between the broadband and narrow band signals. For noise reduction purposes this signal is processed by a minimum limiter made up of transistors VT1 and VT2. The aperture correction signal is generated by operational amplifier A2 and is likewise limited with respect to minimum (VT3 and VT4). The correction unit includes provision for regulating the degree of correction by means of resistive dividers. The high frequency and aperture correction signals are added to the $R^{\gamma}$,$G^{\gamma}$ and $B^{\gamma}$ low frequency signals in summing amplifiers.

The drop in the FCC of the CCD matrices is caused by aperture distortions which crop up due to the ultimate geometrical dimensions of the image elements, by the integrating properties of the output apparatus, by inefficiency of charge transfer [9] and so on. The circuits in Figure 8 are not sufficient for total FCC correction. The model therefore includes additional correction circuits. Since an equivalent circuit of the output apparatus can be represented, accurately enough, as an integrating RC circuit, an FCC drop attributable to output apparatus deficiency can

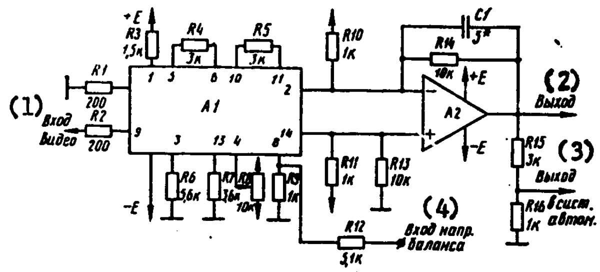

Figure 7. Circuit of Amplifier With Regulated Amplification Factor

Key:
1. Video input
2. Output
3. Output to automatics system
4. Balance voltage input

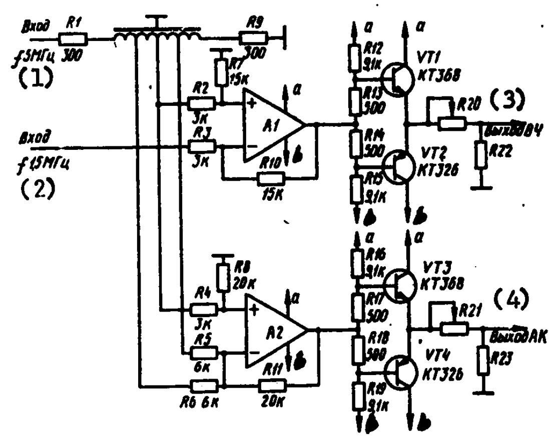

Figure 8. Circuit of the Aperture Correction Unit

Key:
1. Input, f 5 MHz
2. Input, f 1.5 MHz
3. High frequency output
4. Aperture correction output

can be corrected by a capacitive feedback (C*) in operational amplifier A1 of the preamplifier (Figure 5). The circuits for corrections of the FCC drop attributable to inefficiency of charge transfer are examined in detail in [9, 10]. In these circuits the amplitude of the correction signal added to the primary signal is automatically regulated according to the sawtooth (or a more complex) law, depending on the number of charge transfers from a given image element to the output apparatus.

To form pulse trains with a variable PRF, use is made of circuits dividing one common reference frequency $f_0$=29.75 MHz. A functional diagram of the logic circuits for the control of the CCD matrices and part of the synchronizing generator

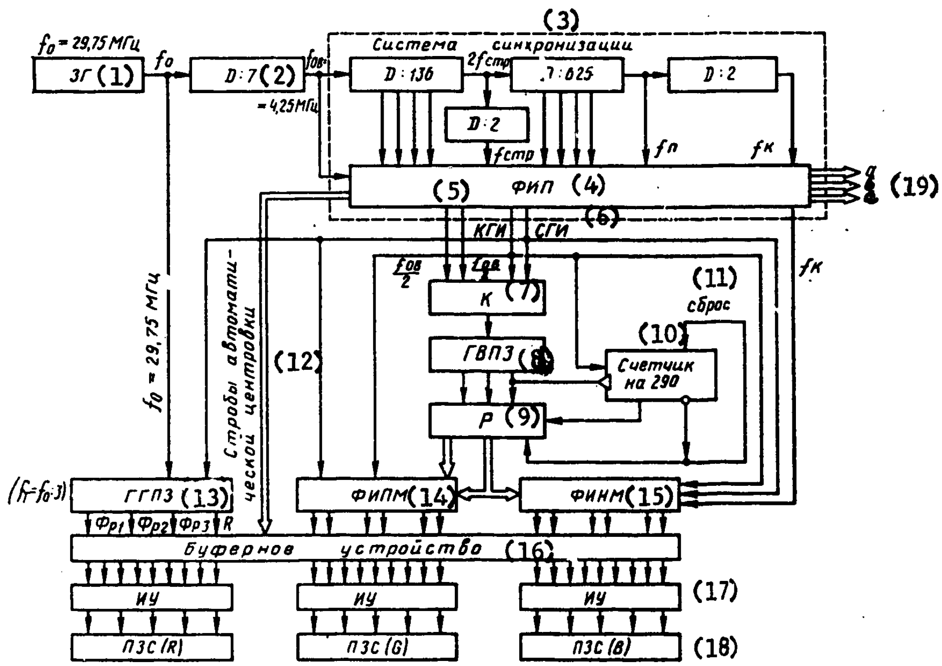


Figure 9. Functional Diagram of the Logic Circuits for CCD Matrix Control

Key:

1. Crystal master oscillator ($f_0$=29.75 MHz)
2. Frequency dividers (D:7, $f_{ov}$=4.25 MHz)
3. Synchronization system ($f_{cmp}$=horizontal frequency, $f_n$= field frequency, $f_K$=frame frequency)
4. Pulse train shaper
5. Frame quenching pulses
6. Horizontal quenching pulses
7. Commutator
8. Three-phase generator for vertical charge transfer
9. Distributor
10. 290-counter
11. Reset
12. Automatic centering gates
13. Three-phase generator for horizontal charge transfer
14. Shaper of pulses for matrix memory section control
15. Shaper of pulses for matrix storage section control
16. Buffer apparatus
17. Pulse amplifiers
18. CCD's (R, G and B)
19. Outputs: a, to SECAM coder; b, to automatics systems; c, to video processor

is presented in Figure 9. A crystal stabilized master oscillator built on a K1LB313 microcircuit operates at the frequency $f_o$=29.75 MHz, equal to triple the frequency of charge transfer from the horizontal registers ($f_T=f_o/3$) and the seventh harmonic of the subcarrier frequency $f_{OV}=f_o/7$=4.25 MHz of the SECAM color TV system. The frequency $f_{OV}$, which is the master frequency for the synchronizing generator and is used in the SECAM coder, is formed by a division of the reference frequency by seven, performed by j-k flip-flops K531TV9P (a TTL with Schottky diodes).

The three-phase generator of pulses for control of the horizontal registers is a circular shift register using j-k flip-flops K531TV9P and is controlled by operational frequencies of $f_o$. The phase is set at the start of each line by horizontal quenching pulses. At the output of this generator are formed three 120°-offset pulse trains for control of the phases of the horizontal registers; the PRF is $f_T=f_o/3$. By a conjunction of the second and third phase pulses, performed by a 159LK1 microcircuit, the generator also forms a sequence of short pulses intended for control of the reset key of the output apparatus ($R_s$).

A background charge ("bold-face" zero) is introduced in order to lower the inefficiency of charge transfer in the output registers. For this purpose constant opening potentials are applied to the input going to the input gates of the horizontal registers. To avoid nonuniformity of background charge input from line to line, which shows up on the image in the form of periodic horizontal bands, there is provision for horizontal phasing of the three phase generator for control of the output registers.

The number of horizontal elements chosen for the CCD matrices was 532. However, at the operating frequency $f_t=f_o/3$, the charges from only 516 elements get into the output apparatus from the horizontal registers during the 52-μsec active part of a line. The charges of the other 16 elements are taken out at the time of the horizontal quenching pulses. This was done in order to check the operation of the system for automatic image centering and to evaluate the advisability of using it in three-matrix color TV cameras. It is proposed later to shield part of these 16 elements on each line from light by means of a protective mask right on the crystal for the purpose of ensuring stable coupling to the black level.

From the output of the three phase generator for control of the horizontal registers, each of the pulse trains which have been formed proceeds to the inputs of three parallel distributing 159LK1 microcircuits where they are gated and then applied across a one-input pulse switch to the appropriate contact of the CCD matrix in channels R, G or B.

The synchronization system combines the actual synchronizing generator, the pulse section of the SECAM coding apparatus, a shaper of signals for controlling the pulse-digital automatics systems and also a shaper of auxiliary pulse sequences for apparatus controlling the storage and memory sections of the CCD matrices. The synchronization system generates pulse trains in accordance with GOST 7845-72 (for the parameters of the synchronization signals) and GOST 19432-74 (for the parameters of the color TV signals), including the signals for receiver synchronization, the mixture of quenching pulses, horizontal quenching pulses, frame quenching pulses, horizontal driving pulses, frame driving pulses, horizontal clamping pulses, and the pulse trains needed to operate the SECAM coder and the automatics systems.

The frequency $f_{ov}=272xf_{str}=4.25$ MHz goes to the input of the synchronizing generator. Double the horizontal frequency, $2f_{str}$, is produced by a /136 divider consisting of series-connected /17 and /8 dividers. By dividing the frequency $2f_{str}$ by 625 via four series-connected /5 dividers, the field frequency $f_p=50$ Hz is produced. The horizontal line frequency $f_{str}$ and the frame frequency $f_k$ are obtained by dividing $2f_{str}$ and $f_p$, respectively, by 2.

The horizontal frequency pulse trains (horizontal quenching, driving, clamping etc.) are formed by means of flip-flops to whose counter inputs is applied a meander of frequency $f_{str}$, and to whose regulating inputs are applied various combinations of signals out of the pattern of frequencies generated by the /136 divider. The frame driving pulse and frame quenching pulse are generated by flip-flops to whose counter inputs is applied a meander of the field frequency $f_p$, and to whose regulating inputs are applied signals from the pattern of frequencies generated by the /625 divider. The other pulse trains are formed in a similar manner. The complex signals needed to control the SECAM coding apparatus are produced by means of additional scaling circuits.

TTL-logic microcircuits (155IYe, K1TK582 and the like) are used in the high frequency input stages of the synchronization system, whereas at lower frequencies, starting from $8f_{str}$, CMOS-logic microcircuits (series 164 and 176) are used. Type 158LA8 TTL circuits with open collector are used as level translators.

The timing diagrams of the pulses for control of the storage and memory sections of CCD matrices with frame transfer of charges are well known [11, 12] and are not included here. Charges in the first field are accumulated at the electrodes of the first phase and, in the second field, at the second and third phase (or second phase only) electrodes. The electrodes of phases not used for charge storage in a given field have a voltage applied to them and the surface layer of the semiconductor then has a concentration of base carriers, which reduces the rate of charge spreading (image blurring) under local exposure to light. During fly-back there are 290 charge transfers from storage section to memory section. A charge in the memory section during forward horizontal scan is stored at the second phase electrodes. For the line-by-line output of the information from the memory section to the output register during fly-back, the pulses of one of the three-phase trains (PRF $f_{ov}/24$ or $f_{ov}/48$) are applied to the electrodes of the phases of the memory section.

The three-phase generator of pulses for vertical transfer of charges is a circular register using j-k flip-flops (TTL). Via a commutator, the generator is controlled during frame quenching pulses by pulses with a PRF of $f_{ov}/2$; in the active part of the field during horizontal quenching pulses it is controlled by pulses with a PRF of $f_{ov}/8$. The three-phase generator converts each of the two pulse trains just mentioned into three offset 120° in phase and with a PRF reduced threefold ($f_{ov}/6$, $f_{ov}/24$).

The transfer of charges from storage section to memory section during frame quenching pulses is controlled by pulses with a PRF of $f_{OV}/6$. There have to be 290 such pulses in each field. A counter working in start-stop mode and a pulse distributor are used to count and separate the necessary number of pulses. The counter is reset by the 290th pulse and started by the frame quenching pulse wavefront. The distributor separates the counted pulses and directs them simultaneously for control of the phases of the storage and memory sections of the CCD matrices. A three-phase train of the two expanded pulses is sent by the distributor to a pulse shaper for control of the memory sections of the CCD matrices where, by means of logic circuits and gating, a triplet of pulses is shaped which controls the line-by-line transfer of charges from the storage section to the output register during the horizontal quenching pulses.

All the pulse trains generated are sent to the CCD matrices across a buffer apparatus and keyed balancing pulse amplifiers. These amplifiers regulate, within 0-20-V limits, the amplitude of the control pulses and shape their front. In order to provide for separate regulation of the CCD matrix operating modes, 10 individual keyed amplifiers are used for each matrix; they are mounted on a separate board and are made up of discrete elements. On this board are four one-input amplifiers which control the output register and six two-input (or three-input) amplifiers which control the storage and memory sections. Each amplifier has independent regulation of pulse amplitudes. The two-input (and three-input) keyed amplifiers are assembled as a parallel summing circuit (Figure 10). The output elements of all the amplifiers are twin complementary emitter repeaters which provide the necessary wavefront length for pulses on a large capacitive load, which the system of electrodes of the matrices is.

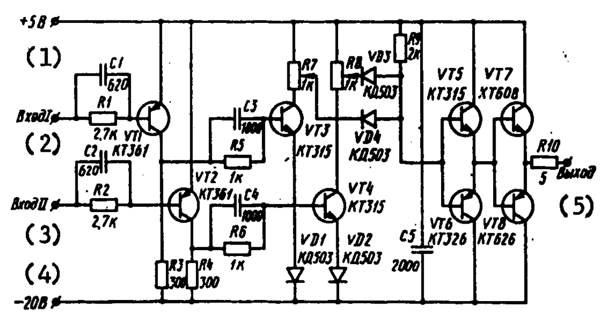


Figure 10. Schematic of a Two-Input Pulse Amplifier (Driver)

Key:
1. +5 V
2. Input I
3. Input II
4. -20 V
5. Output

In connection with the camera model's incorporation of an automatic centering system which operates on the principle of non-simultaneous tapping of information from the storage sections and output registers of the CCD matrices, different gates are used to form the beginning and end of the pulse trains. The gating is performed in a buffer apparatus.

The experimental color TV camera contains four auxiliary automatics systems: balance, luminance regulation, light-diffusion compensation and centering. The first three systems are practically no different from homologous systems used in tube cameras. The automatic centering system is original.

The centering methods employed in tube cameras depend on variation of the constant component of the deflection current in the focussing and deflection system, due to which the scanning pattern is shifted on the target of the transmitting tube. CCD matrices, being devices with a rigid geometry, do not allow the spatial movement of the image by electrical means. Hence, the CCD color TV camera employs an automatic centering system based on non-coincidence, with respect to time, of signals from the various CCD matrices.

The frequency of charge transfer in the output registers of the CCD matrices is $f_T=f_0/3=7/3f_{ov}$. In a horizontal blank, then, there are 16 elements which contain information about the image. This enables shifting in time the start of information readout from the R and B matrix output registers by an interval of plus or minus eight elements relative to the G matrix (Figure 11). The shifting is controlled by gating pulses: reference pulse (Figure 11, c), pulse fixing the center of the zone of regulation and the regulating pulses (Figure 11, d). The position of the trailing edges of the regulating pulses, depending on the sign and magnitude of non-coincidence, is varied according to commands issuing from an analyzer. Automatic centering with respect to vertical is achieved by means of non-coincidence, timewise, of the moments of the start of line-by-line transfer from the memory section to the output register.

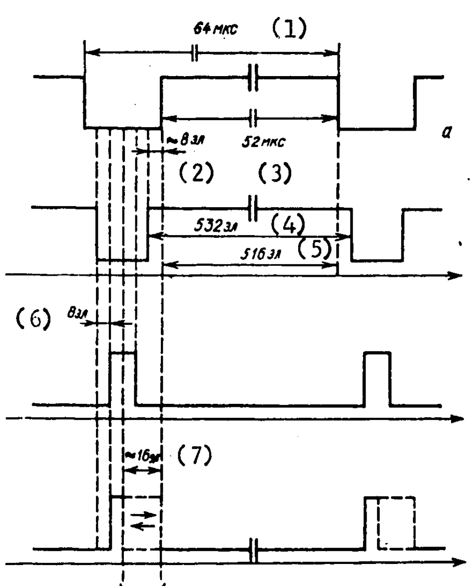


Figure 11. Time Diagrams Illustrating the Principle of Automatic Horizontal Centering of Images

Key:
1. 64 µsec
2. ≈8 elements
3. 52 µsec
4. 532 elements
5. 516 elements
6. 8 elements
7. ≈16 elements
8. Zone for shifting the regulated front

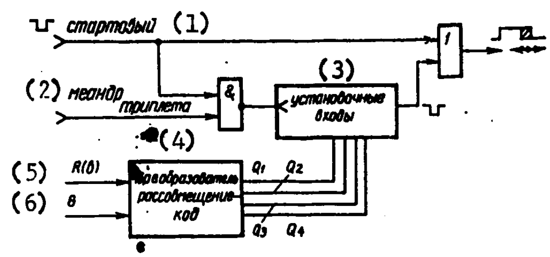


Figure 12. Structural Diagram of Regulating-Pulse Shaper

Key:
1. Starting
2. Triplet meander
3. Regulating inputs
4. Converter for non-coincidence codes
5. R(B)
6. G

The structural diagram of a regulating-pulse shaper is presented in Figure 12. The comparison of optical-type video signals in the basic G channel and the regulated R and B channels, and also the conversion of the non-coincidence signal to digital form are accomplished in a non-coincidence analyzer. The converted non-coincidence signal goes to the regulating inputs of a subtracting counter. At the moment of termination of the auxiliary starting pulse, which is situated within a horizontal or frame quenching pulse depending on which axis is being centered, the pulses of one of the charge transfer phases begin to go to the counter's subtracting input, and the counter's signal returns to 0000 status. The regulating pulse, which consists of a constant part (starting pulse) and the varying part developed by the counter, is shaped by means of logical summation and serves as a gate for the three-phase charge transfer pulses. Due to variation in the duration of the gating pulse, time-coincidence of video signals of the regulated and basic matrices is achieved with a precision of one-half an image element.

The experimental three-matrix CCD color TV camera is of monoblock construction with built-in cassette holder (Figures 13 a and b [photos not reproduced]). The boards for all the systems and apparatus, except those for the keyed amplifiers, are installed in individual guides. The camera weighs about 8 kg and draws about 60 W.

The camera's resolving power with respect to horizontal at the center of the scanning pattern is about 400 TVL (over the height of the scanning pattern). Defects in the CCD matrices and fixed interferences caused by dark current irregularity are the main flaw in color-separated images.

With the experimental model of the color TV camera we obtained the color images of various subjects and color strips. Due to the low sensitivity of the CCD matrices in the blue region of the spectrum, satisfactory images were obtained only with an illumination intensity of 10,000-20,000 lux on the subject at F/2.8 since it was necessary, in order to adjust the light fluxes in the G and R channels, to use, respectively, 3x and 4x light reduction with neutral density filters.

Since the required resolving power in the blue channel is several times less than in the G channel, the sensitivity of a solid state color TV camera with respect to fluctuating interference could be improved by way of summing the charges from individual elements in the B channel, both horizontal and vertical, with the help of delay lines, for instance, or by using CCD matrices with enlarged cells [13, 14]. Moreover, in the horizontal direction the summing of charges from adjacent elements is rather easily done in the floating diffusion region of the output apparatus if charge transfer to that region is accomplished at a frequency $f_T=f_0/3$, subtraction also--at a rate less by a factor of n if short pulses at the frequency $f_T/n$ are applied to the reset transistor ($R_S$). However, in the camera here considered this method of improving sensitivity proved unsuitable because of large dark current irregularity which is markedly dependent on the level of illumination. The camera's sensitivity is therefore limited principally by fixed interference caused by dark current irregularity in the B channel whereas fluctuating interference is practically imperceptible in the image, which is related, too, to the characteristics of its spectral makeup and the peculiarities of visual perception [15]. One possible way to improve the sensitivity of volor TV cameras using charge-coupled devices is to reduce the dark current irregularity.

BIBLIOGRAPHY

1. Milenin, N. K., "Color Television Cameras Using Matrix Image-Signal Shapers," TEKHNIKA KINO I TELEVIDENIYA, No 4, 1981, pp 57-64.

2. Dokuchayev, Yu. P., Kuznetsov, Yu. A. and Press, F. P., "Large Format Matrix Video-Signal Shaper," ELEKTRONNAYA PROMYSHLENNOST', No 7(67), 1978, pp 54-57.

3. Dokuchayev, Yu. P., Kuznetsov, Yu. A. and Press, F. P., "A Matrix Video-Signal Shaper With 580x532 Elements," Ibid., No 10(82), 1979, pp 33-34.

4. "Brief Communications on Color TV Cameras Using CCD's," ELEKTRONIKA, No 2, 1978, p 92; No 7, 1978, pp 13-14; No 14, 1979, p 102; No 3, 1980, pp 17-18; No 4, 1980, pp 15-16; No 16, 1980, pp 10-11; No 21, 1980, p 124.

5. Rodgers, R. L., "Development and Application of a Prototype CCD TV Camera," RCA ENG, Vol 25, No 1, 1979, pp 42-44.

6. Embrey, B. C., "Shuttle Orbiter's Solid-State TV Cameras," 7th Nat. Telecommun. Conf., Birmingham, 1978, Conf. rec., p 10.2.1-10.2.4.

7. Macmann, R. H. et al., "Microcam-1; A New Concept in the Design of Portable Cameras for Broadcasting Application," 10th Annual SMTPE Winter TV Conf., 1976.

8. BROADCASTING ENG., No 9 1980, pp 59-93.

9. Milenin, N. K., Nepomnyashchiy, Yu. Ya. and Rozval, Ya. B. "Correction of Linear Distortions in CCD TV Cameras," TEKHNIKA KINO I TELEVIDENIYA, No 10, 1978, pp 47-55.

10. Milenin, N. K., Nepomnyashchiy, Yu. Ya. and Rozval, A. B., "A Corrector for TV Camera Transient Characteristics," USSR Certificate of Authorship No 718943, Bull. IZOBRETENIYA..., No 8, 1980.

11. Berezin, V. Yu., Kotov, B. A., Lazovskiy, L. Yu., Levin, S. A., Press, F. P. and Rubinshteyn, D. N., "CCD Matrix Television Camera," TEKHNIKA KINO I TELEVIDENIYA, No 6, 1977, pp 54-59.

12. "Charge-Coupled Devices. Technology and Application," Edited by R. Melen and D. Buss, N.Y., IEEE Press, 1976.

13. Milenin, N. K., Polonskiy, Ye. A. and Rozval, Ya. B. "A Color Transmitting Television Camera," USSR Certificate of Authorship No 720817, Bull. IZOBRE-TENIYA..., No 9, 1980.

14. Milenin, N. K., Polonskiy, Ye. A. and Rozval, Ya. B., "Use of Comb-Type Filters in Color TV Cameras," TEKHNIKA KINO I TELEVIDENIYA, No 6, 1979, pp 31-37.

15. Milenin, N. K., "Noise in CCD Image-Signal Shapers," Ibid., No 6, 1980, pp 51-57.



5454
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## IMPROVING NOISE IMMUNITY OF PULSE-TIME AIRCRAFT INSTRUMENT LANDING SYSTEMS

Moscow RADIOTEKHNIKA in Russian Vol 36, No 6, Jun 81 (manuscript received 3 Jun 80) pp 28-31

[Article by A.K. Bernyukov]

[Text] Pulse-time aircraft instrument landing systems (ILS) with beam scanning and time readout, which have advantages in terms of precision and carrying capacity over existing systems, are undergoing intense development at the present time both in the USSR and abroad. The signal from the radio beacon and the input to the on-board system receiver, x(t), because of multipath propagation, contains the components:

$$x(t) = s(t) + s_{\text{по}}(t) + N_{\text{п.п}}(t) + N_{\text{п.а}}(t),\ t \in T_{\text{cк}}, \tag{1}$$

where $s(t) = U(t) \cos(\omega_0 + \omega_Д)t$ is the signal pulse received when the aircraft is irradiated by a scanning, narrow directional beam at a frequency of $\Omega_{CK} = 2\pi/T_{CK}$ ($\omega_0$ and $\omega_Д$ are the carrier and the doppler frequency respectively);

$$s_{\text{по}}(t) = \sum_{l=-}^{L} \dot{p}_l U(t - t_{эl}) \cos[(\omega_0 + \omega_{Дl})t + \varphi_{l0}]$$

are the internal and sidelobe interference, re-reflected from L dominant re-reflectors with local reflection factors of $\dot{p}_l$ and delays of $t_{эl}$; $N_{П.П}(t)$ is interference re-reflected from the rough subjacent surface; $N_{П.а}(t)$ is the additive noise of the receiver and the antenna; U(t) is the law governing the change in the directional pattern of the radio beacon antenna.

A problem of paramount importance in ILS design is combating the influence of multipath interference caused by the bending of the line of position, which makes it difficult to determine the heading (and glide slope) from measurements of the time interval $t^{\pm}_{Н.Г}$ between the pulses $s^+(t)$ and $s^-(t)$ obtained at the receiver output in the case of "back and forth" scanning in a sector $\phi_{Н.Г}$.

Statistical models are known [2 - 5] for the components of the additive mixture (1). The antenna and receiver noise $N_{п.а}(t)$ and the multipath interference from the subjacent surface $N_{п.п}(t)$ are close in their statistical nature (as a rule, they are normal), while the $N_{п.п}(t)$ noise is usually a more narrow band [4 - 6]. When flying along a curved flight path, the signal s(t) fluctuates. One can assume, without taking into account the scanning and the impact of the dominant re-reflectors, that the amplitude of the envelope of the signal and interference mixture has a Rayleigh distribution:

$$\omega(x/s) = x\exp[-x^2/2(1+q^2)]/(1+q^2),\ x \geqslant 0, \qquad (2)$$

where $q = \sqrt{\overline{U}^2_m}/\sigma_N$ is the signal/interference ratio.

Under actual operational conditions of on-board and ground ILS equipment, returns from ground clutter (hangars, control towers, etc.) and periodic evolutions of the power spectrum of the interference $N_{п.п}(t)$ (at the scanning frequency) which are due to the motion of the beam [5], make the process x(t) a nonsteady-state one. Moreover, the mobility of certain re-reflectors, the specific features of airports and nonlinear processing in the on-board receiver introduce a apriori ambiguity into x(t), which makes it difficult to detect the signal and estimate the information parameters by traditional techniques (for example, by means of maximum likelihood processing).

Considering the periodic nature of the scanning in the sectors with respect to the heading and glide slope with a beam of $\phi_{H.\Gamma} = \pm(40° \text{ to } 60°)$ with a directional pattern width of $\alpha$ = 1 to 2°, it is expedient to set up multichannel signal processing in $M = \phi_{H.\Gamma}/\alpha \approx 100$ spatial channels (microsectors) (Figure 1). To resolve the contradiction due to the limited speed of the on-board computers and the considerable volume of computational procedures, it proposed that the processing of x(t) on board be organized in three steps:

1) Spatial selection (primary gating) of the dominant re-reflectors $П_K$ (including the radio beacons) in L channels;

2) Adaptive compensation for the interference in the selected channels (secondary gating) to restore the "form" of the useful signal s(t);

3) Measurement of the information parameter (heading and glide slope).

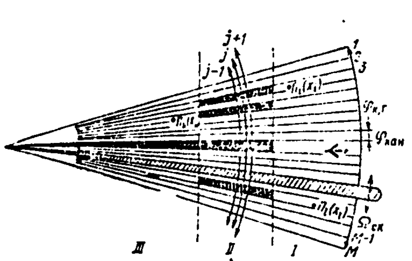

Figure 1.

The basis of the on-board instrumentation computer complex (Figure 2) is a microcomputer (MEVM) which realizes programmed signal processing. For the quantization of the heading and glide slope sectors $\phi_{H.\Gamma}$ into M microsectors (channel intervals of $t_{\text{HaH}}$ [$t_{\text{chan.}}$] = $t_{H.\Gamma}/M$), the synchronizer S generates a reference pulse train at a frequency which is a multiple of the digitization frequency of the channel interval: $F_{\text{ref.}} = T^{-1}_{\text{ref}} = N/t_{\text{chan.}} = NM/T_{H.\Gamma}$, where N is the number of discrete steps in the channel interval $t_{\text{chan.}} = T_{H.\Gamma}/M = \phi_{H.\Gamma}/\Omega_{CK}$ [scan]M. The video mixture of the signal and interference $x_{ц}(t)$ from the output of the on-board receiver (BP) is encoded by means of a high speed analog-digital converter (ATsP). The digital signal $x_{в.ц}(t)$ is fed through the coupler (US) to the microcomputer, which is synchronized with the scanning system.

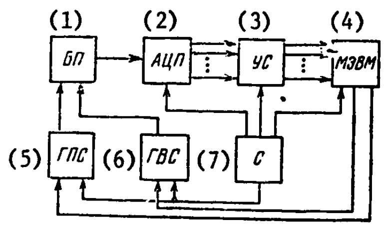


Figure 2.

Key:
1. BP = On-board receiver;
2. ATsP = Analog to digital converter;
3. US = Coupler;
4. MEVM = Microcomputer;
5. GPS = Primary gating generator;
6. GVS = Secondary gating generator;
7. S = Synchronizer.

The spatial gating algorithm for the dominant re-reflectors should be invariant with respect to the interference statistic under the a priori ambiguity conditions. Among the known nonparametric detection algorithms [2, 7], the most efficient in this case is a dual sample ranking algorithm of Wilcoxson, based on a sequential comparison of the sample being studied $\{x_1, \ldots, x_n\}$ of the video process $x_{в.ц}(t)$ with the elements of the reference sample $\{y_1, \ldots, y_n\}$ and then testing the statistic for the threshold C:

$$s = \sum_{i=1}^{N} r_i = \sum_{i=1}^{N}\sum_{j=1}^{M} h(x_i - y_{ij}) \underset{H_0}{\overset{H_1}{\gtrless}} C, \quad h(x_i - y_{ij}) = \begin{cases} 1, & \text{when } x_i \geqslant y_{ij}, \\ 0, & x_i < y_{ij}. \end{cases} \tag{3}$$

A drawback to (3) is the difficulty of obtaining a reference sample of "pure" interference under the conditions of ILS radio beacon operation. For this reason, the following variant (without the reference interference) is proposed:

$$\left\| \begin{matrix} 0, & y_{12}, \ldots, & y_{1M}; & x_1 \\ y_{21}, & 0, \ldots, & y_{2M}, & x_2 \\ \cdots & \cdots & \cdots & \cdots \\ y_{M1}, & y_{M2}, \ldots, & 0; & x_M \end{matrix} \right\| \Rightarrow \left\| \begin{matrix} r_1 = \sum\limits_{j=2}^{M} h(x_1 - y_{1j}), \quad y_{1j} = x_j; \quad j \neq 1 \\ r_2 = \sum\limits_{j=1}^{M} h(x_2 - y_{2j}), \quad y_{2j} = x_j; \quad j \neq 2 \\ \cdots\cdots\cdots\cdots\cdots\cdots \\ r_M = \sum\limits_{j=1}^{M} h(x_M - y_{Mj}), \quad y_{Mj} = x_j; \; j \neq M \end{matrix} \right\|, \quad (4) \qquad (4)$$

where j = 1, 2, ... M are the numbers of the spatial microsectors (channels).

The priority of an element $x_j$ in the microsector of number j relative to the elements $y_{j1}, y_{j2}, \ldots y_{jM}$ is determined in accordance with (4); $y_{jj} = 0$ is all adjacent microsectors with the subsequent testing of the ranks $r_j$ for the threshold C (blocks 1 -- 3 in Figure 3). In channels where $r_j > C$, the dominant signals are gated by instructions from the microcomputer using the primary gating generator

(GPS) pulses. Since algorithm (4) is a variant of (3), inherent in it is immunity to various kinds of interference [7] (including chaotic pulse noise) as well as a considerable dynamic range. Since false alarms are not so dangerous in the primary gating stage (the number of channels being analyzed in the subsequent step is increased somewhat), it is expedient to set the alarm probabilities in a range of $\alpha = 10^{-2} - 10^{-3}$. The calculation of the detection characteristics of the dominant pulses in the video mixture having the distribution of (2) against a background of Rayleigh interference using the procedure of [7] demonstrated the possibility of obtaining a radio beacon detection probability of $D \to 1$ (something which is important when coming in for a landing from a side direction) for the case of smaller (as compared to the case of radar observation) threshold signal/interference ratios (3 to 5 dB).

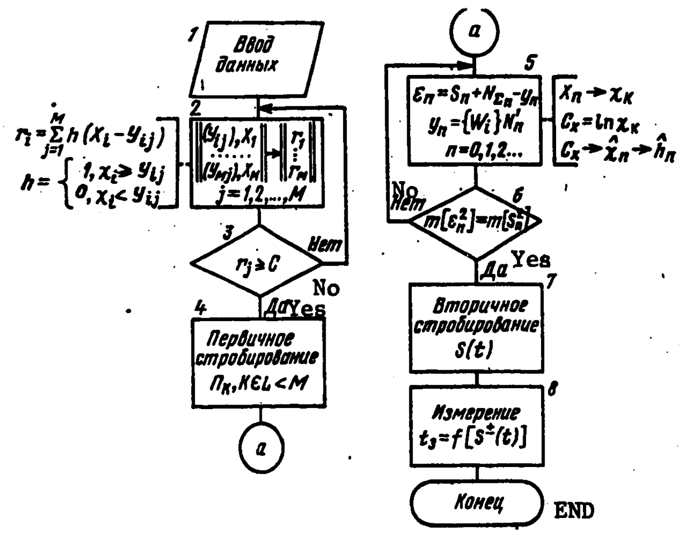


Figure 3.

Key: 1. Data input;
2. [see figure]
3. $r_j \geq C$;
4. Primary gating, $\Pi_K$, K L < M;
5. [see figure];
6. $m[\epsilon_n^2] = m[s_n^2]$;
7. Secondary gating, s(t);
8. Measurement of $t_{delay} = f[s^{\pm}(t)]$.

The spatial selection step takes up an insignificant portion of the landing time. Thus, to service an aircraft descending at a speed of up to 160 km/hr, a radio beacon with a directional pattern scanning frequency of 13.5 Hz at a range of 40 km expends more than $10^5$ scan periods. In the primary gating step, according to (4), about 100 periods will be used when $M \approx 100$.

In the secondary gating step (blocks 5, 6 and 7 in Figure 3), the "form" of the signal s(t) is restored, which was damaged by the interference $N_\Sigma(t) = N_{п.п}(t) + N_{п.а}(t) + s_{п.о}(t)$ and the channel with the radio beacon is gated in accordance with the secondary gating generator signal. Because of the nonsteady-state nature of $N_\Sigma(t)$, the technique of digital adaptive interference compensation is promising, in which the mean square error (SKO) is minimized in the discrete real time $t = nT_0$, $n = 0,1, \ldots, N - 1$ (using "empty" channel intervals ascertained during the primary gating stage) between the process x(n) and the signal $y(n) = N'_{ref}(n)\cdot\{\omega_1, \ldots, \omega_m\}$, generated by an adaptive filter (ADF) with tunable coefficients $\{\omega_i\}$ from the reference interference $N'_{ref}(n)$. The minimum of the mean square error in the channel with the radio beacon is:

$$\min\{m[\varepsilon_n^2]\} = \min\{m[(x_n - y_n)^2]\} = \min\{m[(s_n + N_{\Sigma n} - y_n)^2]\} \underset{i}{\rightarrow} m[s_n^2]; \tag{5}$$

in channels occupied only by interference, $\min\{m[\varepsilon_n^2]\} \to 0$. The presence of intrapath interference $s_{по}(n)$, which distorts s(n) and makes it difficult to compensate for $N_{п.п}(n) + N_{п.а}(n)$, in $N_\Sigma(n)$ impedes the efficient utilization of the well known algorithm for seeking a minimum of the mean square error of [8]. The influence of $s_{п.о}(n)$ can be eliminated and the compensation processes speeded up by segragating the pulse response (IO) h(n) of the medium from the mixture x(n), generating the interference by the technique of homomorphous filtering [9, 10]. In this case, the mixture of the signal and interference

$$x(n) = s(n) + N_\Sigma(n) = s(n) * h(n) = \sum_{(m)} s(m)\, h(n-m) \tag{6}$$

is converted to the frequency region $\omega = k\Delta\omega$, $k = 0,1, \ldots, N - 1$,

$$X(k) = \sum_{n=0}^{N-1} x(n)\, W^{nk} = S(k)\, H(k),\quad W = \exp(-j2\pi/N). \tag{7}$$

Then the inverse transform of the logarithmic spectrum is found:

$$\hat{x}(n) = \frac{1}{N}\sum_{k=1}^{N-1} [\ln X(k)]\, W^{-nk} = \frac{1}{N}\sum_{k=1}^{N-1} [\ln S(k) + \ln H(k)] = \hat{s}(n) + \hat{h}(n). \tag{8}$$

The localized capsters $\hat{s}(n)$ and $\hat{h}(n)$ are segregated, in which case $\hat{h}_N(n)$, which defines the noise $N_{п.п}$ and $N_{п.а}$, is inserted in the adaptive filter for the operational correction of the coefficients $\{\omega_i\}$, i.e., to boost the speed of the adaptive compensator. As an analysis of the mixture on a YeS-1020 computer has shown:

$$x(t) = U_m [\sin \Omega_{ck} t / \Omega_{ck} t + p \sin [\Omega_{ck}(t - t_з)]/[\Omega_{ck}(t - t_з)]]$$

where $u_m = 1$, $p = 0.5$ to 1, $t_з = 0$ to $\pi/\Omega_{CK}$ and $F_{CK} = 13.5$ Hz, the capster $\hat{h}(t)$ is a a decaying pulse train with a period of $t_з$, is separated from the "continuous" capster $\hat{s}(t)$.

## BIBLIOGRAPHY


1. "MLS Multipath Studies", V. 1., Lincoln Laboratory, MIT, Lexington, Massachusets, 1976.

2. Levin B.R., "Teoreticheskiye osnovy statisticheskoy radiotekhniki" ["Theoretical Principles of Statistical Radio Engineering"], Book 3, Moscow, Sovetskoye Radio Publishers, 1976.

3. Kuz'min S.Z., "Osnovy teorii tsifrovoy obrabotki informatsii" ["Principles of Digital Information Processing Theory"], Moscow, Sovetskoye Radio Publishers, 1974.

4. Tartakovskiy G.P., et al., "Voprosy statisticheskoy teorii radiolokatsii" ["Problems in Statistical Radar Theory"], Moscow, Sovetskoye Radio Publishers, 1963.

5. Chechetkin V.D., "Tez. Dokl. XXXIII Vsesoyuz. Nauch. sessii, posvyashchennoy Dnyu radio" ["Abstracts of Reports to the 33rd All-Union Scientific Conference Devoted to 'Radio Day'"], Moscow, Sovetskoye Radio Publishers, 1978.

6. Brown, Gery S., IEEE TRANS., 1977, Vol. 25, No. 1.

7. Akimov P.S., RADIOTEKHNIKA [RADIO ENGINEERING], 1977, Vol. 32, No. 11.

8. Widrow B., Glover D., et al, TIIER [PROC. IEEE (Translated into Russian)], 1975, Vol. 63, No. 12.

9. Rabiner L., Gould B., "Teoriya i primeneniye tsifrovoy obrabotki signalov" ["Theory and Applications of Digital Signal Processing"], Moscow, Mir Publishers, 1978.

10. Oppenheim A., INFORMATION AND CONTROL, 1967, Vol. 11, Nov-Dec.




8225
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PARAMETER SUBSTANTIATION TECHNIQUE FOR ELECTROMAGNETIC INTERFERENCE SIMULATORS

Moscow RADIOTEKHNIKA in Russian Vol 36, No 6, Jun 81 (manuscript received 16 Apr 80) pp 74-76

[Paper by V.V. Kuznetsov, A.A. Lyubomudrov and L.F. Stefanovich]

[Text] Radioelectronic equipment (REA) is frequently subjected to various kinds of electromagnetic interference (EP) (lightning, industrial interference, etc.), which leads to operational dropouts or irreversible failures [1]. When protecting radioelectronic equipment against such interference, tests of noise immunity occupy a special place, which are being conducted with increasing frequency by means of specially designed interference simulators [2]. The problem of selecting the optimal interference simular pulse parameters for the tests has not been solved at the present time. The difficulties involved in its solution are due to the random nature of electromagnetic interference, the complexity of generating pulses with parameters close to the actual ones as well as the diversity of the radioelectronic equipment to be tested. We shall find the optimal parameters of the test pulses based on a probabilistic statistical approach to the tests.

The most complete criterion of radioelectronic equipment efficiency operating in the presence of noise is the successful operation probability, $P_{suc.}$, which should be somewhat greater than a certain probability specified in the technical specifications, $P_{spec.}$, with a confidence level of $P_{con.}$, i.e. [3, 4]:

$$P(P_{suc.} > P_{spec.}) = P_{con.} \tag{1}$$

For this reason, it is expedient to simulate the impact of interference on radio electronic equipment, taking into account the final goal of the test, expressed mathematically by means of (1).

Let $\phi_\pi(\Pi)$ be the distribution density of the random characteristic P of an interference field at the radioelectronic equipment input. Depending on the situation, such a characteristic can be the maximum electrical or magnetic field intensity, or the current or voltage induced by the electromagnetic field in cables or interassembly connections [5, 6]. The distribution density $\phi_\pi(\Pi)$ depends on the interference source power and its distance from the radioelectronic equipment, which are, as a rule, of a random nature. The distributions of the characteristic of П for the case of lightning interference have been found experimentally and theoretically in a number of papers [7, 8].

We shall assume that the timewise characteristics of the interence are either determinate or averaged. In the case where this condition is not met, to avoid omissions of frequency resonance, the timewise characteristics of the test field should run through the entire range of variation in the time characteristics of the interference which are possible in the given situation during the testing process.

The parameters of electromagnetic interference simulators can be substantiated by means of the following method. We first find the minimum permissible level of system immunity to interference, corresponding to the successful operation probability $P_{spec}$. Then, taking into account the statistical scatter in the interference generated by the simulator, its level is determined for the test. Thus, the essence of the method consists in determining the minimum interference level which confirms the minimum permissible successful operation probability $P_{spec}$.

By way of example, we shall consider the case where the transformation of the electromagnetic field of the interference in the shields and circuits of radio electronic equipment and the failures which occur are linear processes. In the case of linear conversion of the random quantity П, there is a change in the scale of the curve $\phi_\pi(\Pi)$, while the overall shape of the distribution curve does not change. The distribution density of the random quantity П reduced by a factor of x times is:

$$\varphi_i(M_i) = \varphi_\text{п}(xM_i)\,x, \tag{2}$$

where $M_i = \Pi/x$ is the amplitude induced in the i-th radioelectronic component.

Let the equipment have a "weak" link, the immunity of which to electrical overloads is substantially less than the immunity of the others. The immunity level $M_э$ [$M_e$] of the "weak" link component to electrical overloads has a statistical scatter which can be described by the probability density $\phi_e(M_e)$. From the equation [9]

$$P_{spec} = P_{\text{т.з}} = \int_0^\infty \varphi_э(M_э)\,dM_э \int_0^{M_э} \varphi_\text{п}(x_\phi M_i)\,x_\phi\,dM_i, \tag{3}$$

taking (2) into account, we shall find the minimum permissible attenuation factor $x_\phi$ of the amplitude of the interference П, at which the specified probability of successful operation of the equipment $P_{spec}$ is just achieved.

Let the laws governing the scatter $\phi_И(\Pi_И)$ of the interference amplitude from the simulator be known relative to any nominal value $m_И$ specified beforehand. We find the desired interference level $m_{И.\phi}$ for the tests from the following equation:

$$P_{\text{т. э}} = \int_0^\infty \varphi_э(M_э)\,dM_э \int_0^{M_э} \varphi_и(x_\Phi M_{iи})\,x_\Phi\,dM_{iи}, \tag{4}$$

where $M_{iи} = \frac{П_и}{x_\Phi}$.

For normal distributions of $\phi_\pi(\Pi)$, $\phi_e(M_e)$ and $\phi_И(\Pi_И)$ with mean values and mean square deviations of $m_\pi$ and $\sigma_\pi$, $m_e$ and $\sigma_e$ and $m_И$ and $\sigma_И$, we obtain the following from (3) and (4) respectively following transformations:

$$P_{\text{т. э}} = \Phi\left\{\frac{m_э - (m_п/x_\Phi)}{\sqrt{\sigma_э^2 + (\sigma_п/x_\Phi)^2}}\right\}, \tag{5}$$

$$P_{\text{т. э}} = \Phi\left\{\frac{m_э - (m_{и.\Phi}/x_\Phi)}{\sqrt{\sigma_э^2 + (\sigma_{и.\Phi}/x_\Phi)^2}}\right\}, \tag{6}$$

where $\Phi\{y\}$ is the probability integral; $\sigma_{И.\Phi}$ is the mean square deviation from the nominal value of $m_{И.\Phi}$. An analysis of equations (5) and (6) shows that with an increase in $P_{spec}$, $x_\Phi$ and $m_{И.\Phi}$ also increase.

For normal distribution of the load and immunity, the proposed technique can also be used in the case of an unknown immunity of the components to electrical overloads. In this case, it is essential to known only the coefficient of variation $\sigma_e/m_e$, the value of which depends on the perfection of the production technology for the radioelectronic equipment components. By dividing the numerator and denominator of the expressions inside the curly braces in equation (5) and (6) by $m_Э$ [$m_e$] and writing $x'_\Phi m_e = x_\Phi$, we obtain:

$$P_{\text{т. э}} = \Phi\left\{\frac{1 - m_п/x'_\Phi}{\sqrt{(\sigma_э/m_э)^2 + (\sigma_п/x'_\Phi)^2}}\right\}, \quad P_{\text{т. э}} = \Phi\left\{\frac{1 - m_{и.\Phi}/x'_\Phi}{\sqrt{(\sigma_э/m_э)^2 + (\sigma_{и.\Phi}/x'_\Phi)^2}}\right\}. \tag{7}$$

In the case of unknown coefficients of variation $\sigma_e/m_e$ and $\sigma_И/m_И$ we find the quantity $m_{И.\Phi}$ from (7). As we see, an increase in the ratio $\sigma_e/m_e$, $m_{И.\Phi}$ decreases. Consequently, for an unknown immunity of the system components to electrical overloads, the customer designating the interference level for the tests should use as the basis the smallest possible coefficient of variation of component immunity. It is expedient to determine the latter in laboratory tests. Moreover, one can make use of the data for similar components.

In the case of a sophisticated production technology for the components, equations (3) and (4) are simplified:

$$P_{\text{т.э}} = \int_0^{M_э} \varphi_{\text{п}} (x_\Phi M_l) x_\Phi \, dM_l, \qquad P_{\text{т.э}} = \int_0^{M_э} \varphi_{\text{и}} (x_\Phi M_{l\text{и}}) x_\Phi \, dM_{l\text{и}}. \tag{8}$$

With sufficiently good repeatability of the interference amplitude from the simulator, equation (8) assumes the form: $m_{И.\Phi} = M_e x_\Phi$.

The number of samples for the tests is determined from Pearson's and Klopper's formula [4].

The transformation of the electromagnetic field in radioelectronic equipment can, in the most general case, be the consequence of nonlinear processes. The immunity of nonlinear components to electrical overloads is no longer described by the amplitude of the induced voltage (as in the case of linear systems), but rather by the induced energy or power. When interference flows through nonlinear systems, the distributions governing the interference characteristics change their form. For this reason, even if the distribution of the immunity of the individual system components to electrical overloads is known, the law governing the distribution of the nonlinear system immunity $\phi_{CT}(\Pi_{CT})$ is most often unknown. We approximate the distribution of nonlinear system immunity to interference with a normal distribution, by specifying a sufficiently low coefficient of variation $\sigma_{CT}/m_{CT}$. We find a certain boundary distribution density from (3), $\phi_{CT.\Phi}$ $(\Pi_{CT})$ having a mean value of $m_{CT.\Phi}$ and a mean square deviation of $\sigma_{\text{ст.ф}} = \frac{\sigma_{\text{ст}} m_{\text{ст.ф}}}{m_{\text{ст}}}$, corresponding to the successful operation probability:

$$P_{\text{spec}} = P_{\text{т.э}} = \int_0^\infty \frac{1}{\frac{\sigma_{\text{ст}} m_{\text{ст.ф}}}{m_{\text{ст}}} \sqrt{2\pi}} e^{-\frac{(\Pi_{\text{ст}} - m_{\text{ст.ф}})^2}{2\left(\frac{\sigma_{\text{ст}} m_{\text{ст.ф}}}{m_{\text{ст}}}\right)^2}} d\Pi_{\text{ст}} \int_0^{\Pi_{\text{ст}}} \varphi_{\text{п}} (\Pi) \, d\Pi.$$

We determine the desired interference level for the tests, $m_{И.\Phi}$, the scatter in which is characterized by the distribution density $\phi_{И.\Phi}(\Pi_И)$, from an equation analogous to (4):

$$P_{\text{т.э}} = \int_0^\infty \frac{1}{\frac{\sigma_{\text{ст}} m_{\text{ст.ф}}}{m_{\text{ст}}} \sqrt{2\pi}} e^{-\frac{(\Pi_{\text{ст}} - m_{\text{ст.ф}})^2}{2\left(\frac{\sigma_{\text{ст}} m_{\text{ст.ф}}}{m_{\text{ст}}}\right)^2}} d\Pi_{\text{ст}} \int_0^{\Pi_{\text{ст}}} \varphi_{\text{и.ф}} (\Pi_{\text{и}}) \, d\Pi_{\text{и}}.$$

Moreover, when testing nonlinear systems to find the possible amplitude resonances, it is necessary to act on one of the samples with a stepped changing load in a range of variation of П from zero to $m_{м.ф}$.

BIBLIOGRAPHY

1. Naumov Yu.Ye., Avayev N.A., Bedrekovskiy M.A., "Pomekhoustoychivost' ustroystv na integral'nykh logicheskikh skhemakh" ["The Interference Immunity of Devices Using Logic IC's"], Moscow, Sovetskoye Radio Publishers, 1975.

2. Galkin A.P., Lapin A.N., Samoylov A.G., "Modelirovaniye kanalov sistem svyazi" "Modeling the Channels of Communications Systems"], Moscow, Svyaz' Publishers, 1979.

3. Gurvich I.S., "Zashchita EVM ot vneshnikh pomekh" ["Protecting Computers against External Interference"], Moscow, Energiya Publishers, 1975.

4. Pupkov K.A., Kostyuk G.A., "Otsenka i planirovaniye eksperimenta" ["The Evaluation and Planning of an Experiment"], Moscow, Mashinostroyeniye Publishers, 1977.

5. Alizady A.A., Khydyrov F.L., ELEKTRICHESTVO [ELECTRICITY], 1978, No 9.

6. Bazutkin V.V., Zaporozhchenko S.I., ELEKTRICHESTVO, 1975, No 1.

7. Bronfman A.I., "Rezhimy raboty ventil'nykh razryadnikov pri grozovykh perenapryazheniyakh" ["Operational Modes of Diode Dischargers in the Case of Lightning Induced Overvoltages"], Moscow, Energiya Publishers, 19771

8. Alizade A.A., Muslimov M.M., Khydyrov F.L., ELEKTRICHESTVO, 1976, No 11.

9. Kapur L., Lamberson L., "Nadezhnost' i proyektirovaniye sistem" ["Systems Design and Reliability"], Moscow Mir Publishers, 1980.



8225
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APPLYING POSINOMIAL ESTIMATE TO EFFICIENCY DETERMINATION OF EQUIPMENT WITH HIGH ELECTROMAGNETIC COMPATABILITY INDICATORS

Moscow RADIOTEKHNIKA in Russian Vol 36, No 6, Jun 81 (manuscript received 2 Jan 80) pp 76-77

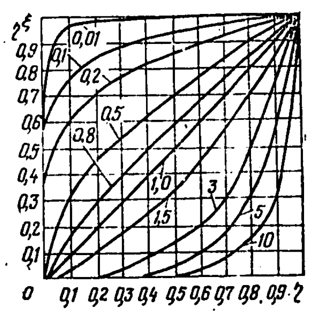
[Article by A.D. Kaluzhskiy]

[Text] The electromagnetic compatability (EMS) indicators of equipment can be improved in the general case by means of incorporating additional devices (DU) and by changing the characteristics of the equipment itself, for example, the linearization of operational modes of amplifiers and additional shielding of assemblies. This entails a change in a number of equipment indicators, and consequently, in equipment efficiency.

The problem of obtaining a function for the change in equipment efficiency when improving its electromagnetic compatability indicators is a particularly acute one now, since an improvement in electromagnetic compatability indicators of equipment is accompanied by an increase in equipment complexity, size, weight as well as a degradation of a number of other characteristics, something which at a certain point leads to a reduction of equipment efficiency as a whole [1]. When deriving such a function, it is necessary to choose an optimum design variant for the equipment for each value of the electromagnetic compatability indicator and correspondingly determine the weighting factors for each of its indicators. The specific features of this task are those situations where an improvement in electromagnetic compatibility indicators leads to a slight change in some of the equipment indicators, while others are constant. In this case, a nonlinear estimate of the efficiency is needed which makes it possible to ascertain and not lose these changes. It is expedient to use posinomials as such estimates: a nonlinear estimate proposed by R. Daffine, et al. [2], and used to estimate the efficiency of communications systems by Yu.M. Vozdvizhenskiy [3]. A special case expression for such an estimate has the form:

$$L_k = \prod_i \eta_{ik}^{\xi_i}, \qquad (1)$$

where k is the number of draft designs of the equipment, each of which has its own electromagnetic compatibility indicator; $L_k$ is the efficiency of the k-th design; $\eta_{ik}$ is the coefficient of success of the i-th indicator of the k-th equipment design; $\xi_i$ is a coefficient which is defined as the weighting factor of the i-th equipment indicator. In (1), the quantity $\eta_{ik}$ can be defined by the relationships of [4]: $\eta_{ik}=\alpha_{i\,min}/\alpha_{ik}$, $\eta_{ik}=\alpha_{ik}/\alpha_{i\,max}$. where $\alpha_{ik}$ is the value of the i-th indicator of the k-th draft design of the equipment; $\alpha_{i\,min}$ and $\alpha_{i\,max}$ are the best values of the i-th indicator from among the k designs considered for the equipment.




To determine the value of $\xi_i$, we plot the family of curves $\eta^\xi$ for various values of $\xi$ (see the figure). Since small deviations of $\alpha_i$ from $\alpha_{i\,max}$ and $\alpha_{i\,min}$ are assumed, and consequently, also small deviations of $\eta$ from 1, and a significant change in $\eta^\xi$, then $\xi$ should vary from 1 to $\infty$, i.e., $1 \leq \xi \leq \infty$. At the same time it is apparent that the greater the weighting factor, the smaller the value of L should be; moreover, the value of the weighting factors $\beta_i$ usually falls in a range of 0 to 1. All three conditions will be met if we set $\xi_i = 1/\beta_i$.

The effectiveness of the k-th design in this case will be defined as:

$$L_k=\prod_i \eta_{ik}^{1/\beta_i}. \tag{2}$$

By utilizing (2), one can plot the value of the equipment effectiveness as a function of its electromagnetic compatibility indicators for the case of sufficinetly small variations in the effectiveness and find the value of the electromagnetic compatibility indicator for which the equipment will have the maximum efficiency, i.e., determine the optimal design variant of the equipment.

*Example.* We shall consider the design variants of equipment for two values of the electromagnetic compatibility indicator (k = 2), in which the case the number of indicators is i = 2 and one of the indicators does not change. Let $\eta_{11} = \eta_{12} = 0.8$; $\eta_{21} = 0.93$; $\eta_{22} = 0.95$; $\beta_{11} = \beta_{12} = 0.7$; $\beta_{21} = \beta_{22} = 0.3$. By substituting the indicated quantities in (2) and using the curves depicted in the figure, we attain values of the effectiveness of $L_1 = 0.504$ and $L_2 = 0.576$.

The example cited here shows that a difference in the values of only one indicator by two percent in all leads to a difference in efficiency values by more than 14 percent, something which makes it possible to more precisely select the optimal equipment design variant.

BIBLIOGRAPHY

1. Kaluzhskiy A.D., RADIOTEKHNIKA, 1981, Vol 36, No 5.

2. Daffin R., et al., "Geometricheskoye programmirovaniye" ["Geometric Programming"], Moscow, Mir Publishers, 1972.

3. Vozdvizhenskiy Yu.M., TRUDY UCHEBNYKH INSTITUTOV SVYAZI [PROCEEDINGS OF THE COMMUNICATIONS TRAINING INSTITUTES], 1974, No 69.

4. Okunev Yu.B., Plotnikov V.G., "Printsipy sistemnogo podkhoda k proyektirovaniyu v tekhnike svyazi" ["The Principles of a Systems Approach to Design in Communications Engineering"], Moscow, Svyaz', 1976.



8225
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MICROELECTRONICS

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## MAGNETICALLY TUNED SEMICONDUCTOR MICROWAVE DEVICES

Moscow RADIOTEKHNIKA in Russian Vol 36, No 6, Jun 81 (manuscript received 28 Aug 80) pp 23-27

[Paper by V.P. Gololobov, V.I. Tsymbal and G.N. Shelamov]

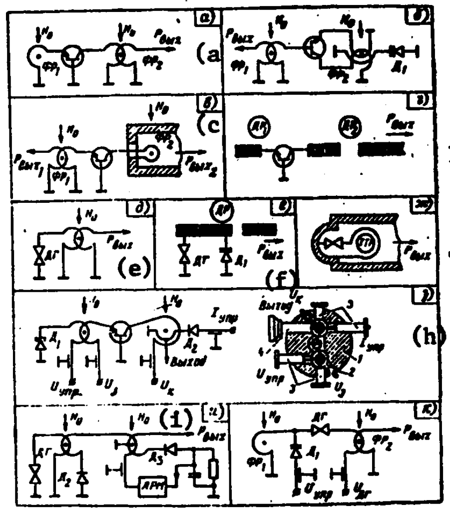
[Text] The results of a study of various magnetically tuned microwave devices are given (oscillators, filters, frequency multipliers, selective mixers, frequency discriminators and heterodyne frequency converters). The necessity of designing multifunction complex microwave devices is noted; these include superheterodyne magnetically magnetically tuned modules.

An urgent question in microwave electronics is the design of combined devices using solid state resonators (TTR), where these devices take the form of a combination of ferrite (FR) or dielectric (DR) resonators with semiconductor devices (Gunn diodes, transistors, varactors, mixer and p-i-n diodes). Such devices include oscillators, filters, frequency converters and superheterodyne modules.

In the process of studying semiconductor magnetically tuned microwave devices, in which ferrite resonators are incorporated by means of one or more coupling turns, the interaction of ferrite resonators with n turns was analyzed [1], as well as selective matching networks based on ferrite resonators [2, 3] and ferrite varactor networks which provide for fine tuning the ferrite resonator frequency independently of the level of the magnetizing field [4]; selective circuits based on ferrite resonators have been designed for a specified circuit function (input impedance, transmission factor); microwave devices have been designed in a linear approximation [3 - 8] based on the impedance and wave parameters of the major components which were measured or calculated beforehand (ferrite resonators and semiconductor devices).

Transistors are used as the active elements in solid state microwave oscillators for the decimeter band and Gunn diodes (DG) are used for the centimeter and millimeter bands. The most promising are dual resonator oscillators [6, 7], which as compared to single resonator oscillators [9 - 11] provide for an expansion of the tuning range, simplification of the tuning and increased frequency stability. Some three main variants for the design of transistorized oscillators are known using two solid state resonators [3]: a simple three-point circuit (Figure 1a, c, d), a circuit with transformer feedback (Figure 1b) and a "modified" three-point circuit with a matching transformer. The most widespread circuit for diode microwave

дp =
= dielectric
resonator




(b)
фp = Ferrite
resonator
(d)
$P_{\text{вых}} = P_{\text{out}}$
(g)
дг = Gunn diode
выход = output
$I_{\text{упр}} = I_{\text{control}}$
(h)
$U_{\text{упр}} = U_{\text{control}}$
(j)
APM = Automatic
power
control

*Рис. 1*

Figure 1.

oscillators is the transformer circuit (Figure 1e) in which the ferrite resonator is arranged in two orthogonal turns, one of which is connected to the Gunn diode, while the other is connected to the load. In the oscillator configurations depicted in Figures 1e and f, the solid state resonator plays the part of a selective matching transformer which provides for the resonant nature of the coupling of the oscillator to the load, and consequently, a lower level of spurious frequencies at the output.

The authors have proposed the use of varactors [3] for "fast" frequency tuning of semiconductor microwave magnetically tuned oscillators, something which is necessary in the realization of phase locked loop frequency tuning systems. Various methods of inserting the varactors $D_1$ in the oscillator circuits are shown in Figures 1b, f, h and j. More suitable are the circuits in which the varactor is connected to a supplemental turn, which is coupled to one of the ferrite resonators of the oscillator. A characteristic feature of these circuits is the absence of additional elements for decoupling the power supply for the active semiconductor device and the veractor control circuit. Moreover, the influence of the veractor in such oscillators is manifest only at frequencies close to the ferromagnetic resonance frequency (FMR), while for other methods of veractor insertion, self-excitation of the oscillator is observed at frequencies other than the FMR frequency, something which is undesirable.

Electrical control of the output power level is accomplished by means of p-i-n diodes. In the oscillator design in the configuration depicted in Figure 1h [12], the p-i-n diode $D_2$ is connected to one the symmetrical leads of the power tap turn, while the load is connected to the center tap of this turn. The output power is reduced with an increase in the current through the diode, i.e., when its resistance decreases. The constant output power in the frequency range is achieved by the use of an automatic control system (ARM), the realization of which involves the use of detector $D_3$: a heterodyne power level sensor (Figure 1i).

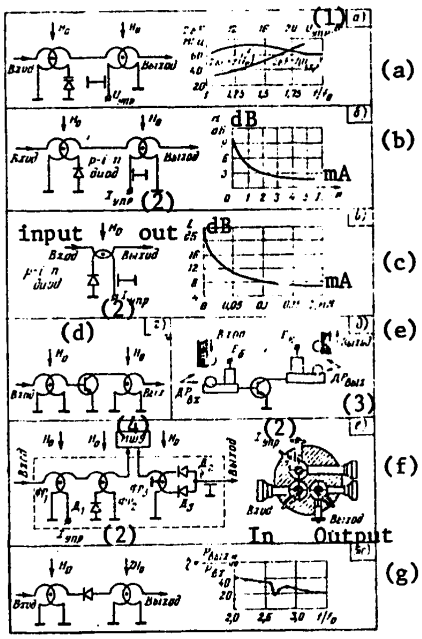



Figure 2.

Key: 1. Control voltage, volts;
2. Control current;
3. Output dielectric resonator;
4. Low noise amplifier.

The tuning range of semiconductor oscillators based on solid state resonators can be expanded by using the second harmonic of the generated signal. For this, a waveguide section is inserted between the oscillator and the load, a section which blocks the first harmonic and regularly passes the second (Figure 1c, g). In this case, the expansion of the frequency band is not tied to an increase in the resonator magnetization field, and consequently, an increase in the size and weight of the magnet system, something which is especially important for millimeter band oscillators.

The basis for the structural design of magnetically tuned devices is the microwave assembly which is placed between the poles of a magnet system. A radial cylindrical structural configuration for the microwave assembly of a dual resonator transistorized oscillator is shown in Figure 1h. Resonator holders 2, feed-through capacitors 3 and coaxial cable sections 4 are installed in cylindrical housing 1 radially with respect to the holes in which the set of ferrite resonator turns are positioned. Such an arrangement provides for convenience in assembly, tuning and the replacement of individual device components.

Solid state microwave filters based on ferrite and dielectric resonators have been described in numerous papers, for example, in [4, 13-15]. The utilization of semiconductor devices makes it possible to adjust and improve the parameters of the filters. Thus, in ferrite filters with loop coupling elements, the use of a varactor (Figure 2a) expands the passband by several times [8], while the insertion of a p-i-n diode in the filter circuitry provides for adjusting the foreward loss level by 20 dB for a dual-resonator bandpass filter (Figure 2b) and by 15 dB for a single resonator stopband filter (Figure 2c). The transistor in "active" microwave filters (Figures 2d, e) is inserted between two selective matching four-pole networks, designed around solid state resontators. Ferrite filters ($FR_1$ and $FR_2$) having a transfer gain which can be electrically controlled by means of p-i-n diode $D_1$, are used in the input device (Figure 2f) as well as a low-noise amplifier MShU and a selective detector ($FR_3$, $D_2$ and $D_3$), designed in a balanced circuit configuration; the filter and the detector are structurally combined in a single microwave assembly.

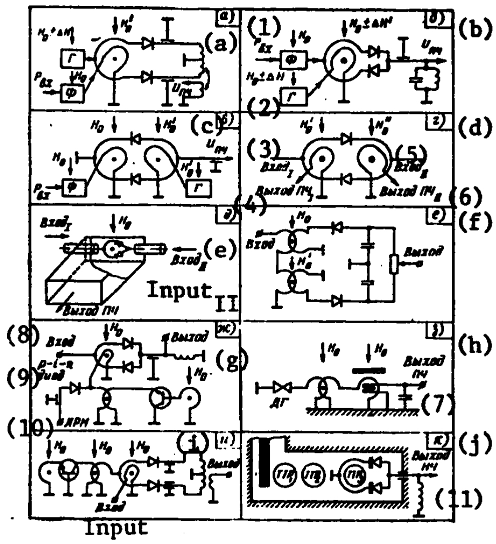



Figure 3.

Key:
1. Power input;
2. Beat frequency oscillator;
3. Input I;
4. Intermediate frequency 1 output;
5. Input II;
6. Intermediate frequency II output;
7. IF output;
8. Input;
9. p-i-n diode;
10. Automatic power control;
11. Low frequency output.

Frequency multipliers in which ferrite resonators are used as the selective systems effectively supplement and expand the capabilities of semiconductor microwave oscillators. Multipliers designed in a dual tuned circuit configuration (figure 2g) possess the best characteristics, in which the nonlinear element is inserted between two gang tuned filters, which are tuned to the first and the n-th harmonic of the oscillator frequency. In a doubler which was studied, the efficiency varied from 40 percent to 25 percent in 40 percent of the passband, while the efficiency of a doubler with a single ferrite filter did not exceed 15 percent [16].

In the frequency converters described below, the nonlinear elements are semiconductor devices, while the ferrite resonator operates in a linear mode.

Selective mixers are designed in various circuit configurations [8, 17], the major ones of which are shown in Figures 3a, b and c. The mixer resonators are tuned to the input signal frequency or the heterodyne frequency, while in mixers with a "high" intermediate frequency (Figures 3d and e), they are tuned to the output signal frequency. In the mixer depicted in Figure 3e, the waveguide is a regular waveguide for the intermediate frequency signal and a blocking waveguide for the input signals.

A heterodyne frequency converter (Figure 3g) takes the form of the combination of a beat frequency oscillator and a selective mixer. The choice of a balanced mixer configuration and the tuning of the mixer ferrite resonator to the heterodyne frequency reduces the level of parasitic frequency components both at the input and at the output of the mixer; the attenuation of the back radiation of the BFO amounts to -20 dB. A schematic of a heterodyne converter designed around a ferrite mixer is shown in Figure 3h. The ferrite resonator with two orthogonal windings, one of which (the IF signal power tap coil) is perpendicular to the direction of the magnetizing field, is placed inside the waveguide, in particular, in a asymmetrical stripline. Such an orientation provides for decoupling between all of the inputs of the converter on the order of 25 dB. One of the most preferable asynchronous detector circuits from the viewpoint of suppression of heterodyne noise is the converter with an intermediate frequency of zero, which is shown in Figure 3i. In it, the tuned frequencies of the ferrite resonators are equal, something which facilitates their gang tuning and makes it possible to use a ferrite filter at the input which is tuned to the same frequency, the use of which is not essential, but is desirable from the viewpoint of attenuating the impact of "high power" signals on the normal operation of the mixer diodes.

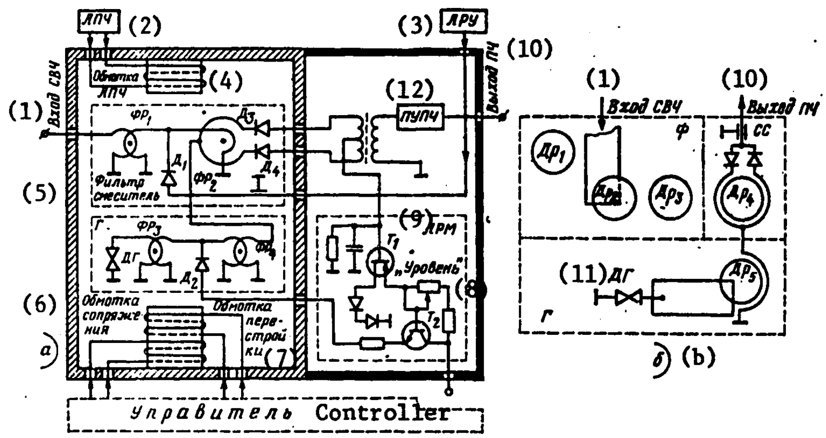



Figure 4.

Key: 1. Microwave input;
2. Automatic intermediate frequency control;
3. Automatic gain control;
4. Automatic intermediate frequency control winding;
5. Mixer filter;
6. Coupling winding;
7. Tuning winding;
8. "Level" [control];
9. Automatic power control;
10. Intermediate frequency output;
11. Gunn diode.

A filter designed around a solid state resonator and semiconductor diodes which are connected to a winding coupled to one of the resonators are used together in selective detectors (Figures 2g and 3j).

The sensitivity to a change in the input signal frequency with respect to the ferromagnetic resonance frequency in microwave frequency discriminators is achieved by using a system of two mutually mistuned resonators (Figure 3f) or one ferrite resonator positioned in a position of orthogonal turns with the appropriate commutation of the leads of these turns.

Superheterodyne microwave modules [18] which take the form of complex combination devices perform the functions of spectrum filtering and transposition. Included in the modules (Figure 4) are a filter F, beat frequency oscillator G, a selective mixer SS, an intermediate frequency preamplifier PUPCh and an ARM system [automatic power control]. The filter, beat frequency oscillator and mixer in the module (Figure 4a) are placed inside a single magnet system [19, 20], which contains windings for tuning, coupling and automatic tuning of the heterodyne frequency, APCh; a p-i-n diode is connected to the ferrite filter, to which the automatic gain control signal is fed, the ARU signal, with the appropriate delay.

The tuning of the modules in a wide frequency range is accomplished by changing the current in the winding; tuning in a narrow range (in the case of a broadband filter) is accomplished by changing only the heterodyne frequency. The frequency tuning range of the module is governed by the working range of the heterodyne stage and the degree of matching of the tuning characteristics of the module components. The sensitivity of the module depends on the sensitivity of the selective mixer and the forward losses of the filter; the passband and the image rejection are governed by the numbers of resonators in the filter. An increase in the selectivity is achieved by inserting resonator $DR_1$ [dielectric resonator 1] at the input to the module (Figure 4b) as a stopband filter, the tuned frequency of which is equal to the image channel frequency. The output signal intermediate frequency, i.e., the difference between the tuned frequencies of the filter and the beat frequency oscillator, can be set in a range of from tens to several hundreds of megahertz by varying the current in the coupling winding.

BIBLIOGRAPHY


1. Bokrinskaya A.A., Tsymbal V.I. Shelamov G.N., RADIOTEKHNIKA [RADIO ENGINEERING], 1979, Vol 34, No 4.

2. Tsymbal V.I., Shelamov G.N., RADIOTEKHNIKA, 1978, Vol 33, No 10.

3. Kovbasa A.P., Shelamov G.N., Gololobov V.P., Tsymbal V.I., "Magnitno-upravlyayemyye ustroystva SVCh s lineynoy perestroykoy chastoty" ["Magnetically Controlled Microwave Devices with Linear Frequency Tuning"], Part 1., "Poluprovodnikovyye generatory" ["Semiconductor Oscillators"], "Rumb" Central Scientific Research Institute, 1977.

4. Gololobov V.P., Tsymbal V.I., Shelamov G.N., "Ferritovyye SVCh rezonatory i ikh primeneniye" ["Ferrite Microwave Resonators and Their Applications"], Kiev, "Znaniye" ["Knowledge"] Society of the UkrSSR, 1979.

5. Tureyeva O.V., Tsymbal V.I., Shelamov G.N., VESTNIK KIYEVSKOGO POLITEKHNICHESKOGO INSTITUTA. SERIYA RADIOTEKHNIKA [BULLETING OF KIEV POLYTECHNICAL INSTITUTE. RADIO ENGINEERING SERIES], 1977, No. 14.

6. Gololobov V.P., Tsymbal V.I., Shelamov G.N., IZVESTIYA VUZOV SSSR, SERIYA RADIOELEKTRONIKA [PROCEEDINGS OF THE HIGHER EDUCATIONAL INSTITUTES OF THE USSR, RADIOELECTRONICS SERIES], 1977, Vol 20, No 10.

7. Tsymbal V.I., Shelamov G.N., VESTNIK KIYEVSKOGO POLITEKHNICHESKOGO INSTITUTA SERIYA RADIOTEKHNIKA, 1978, No 15.

8. Gololobov V.P., Ishchenko M.G., Tureyeva O.V., Tsymbal V.I., Shelamov, G.N., IZVESTIYA VUZOV SSSR, SERIYA RADIOELEKTRONIKA, 1979, Vol 22, No 5.

9. Ollwier P. IEEE J. SOLID-STATE CIRCUITS, 1972, Vol 7, No 1.

10. Shelamov G.N., IZVESTIYA VUZOV SSSR. SERIYA RADIOELEKTRONIKA, 1974, Vol 27, No 8.

11. Vyz'minova M.D., et al., TEKHNIKA SREDSTV SVYAZI, SERIYA RADIOIZMERITEL'NAYA TEKHNIKA [COMMUNICATIONS EQUIPMENT ENGINEERING, RADIO MEASUREMENT EQUIPMENT SERIES], 1976, No 5.

12. USSR Patent No. 725195, "Generator SVCh" ["A Microwave Oscillator"], Gololobov, V.P., Ishchenko M.G., Misevich V.I., Shelamov G.N., Tsymbal V.I..

13. Lebed' B.M., Nikolayeva K.S., Smol'kov V.I., Paper in the book, "Ferritovyye SVCh pribory i materialy" ["Microwave Ferrite Devices and Materials"], Moscow, "Elektronika" All-Union Scientific Research Institute, 1970, No 1 (17).

14. Il'chenko M.Ye., Melkov G.A., Mirskikh G.A., "Tverdotel'nyye SVCh fil'try" ["Solid-State Microwave Filters"], Kiev, Tekhnika Publishers, 1977.

15. Kovbasa A.P., Shelamov G.N., Gololobov V.P., Tsymbal V.I., "Magnitno-upravlyayemyye ustroystva SVCh s lineynoy perestroykoy chastoty." ["Magnetically Controlled Microwave Devices with Linear Frequency Tuning"], Part 2, "Preobrazovateli chastoty i fil'try" ["Frequency Converters and Filters"], "Rumb" Central Scientific Research Institute, 1978.

16. Shitov A.M., Kireyev V.S., VOPROSY RADIOELEKTRONIKI, SERIYA RADIOIZMERITEL'NAYA TEKHNIKA [QUESTIONS IN RADIOELECTRONICS. RADIO MEASUREMENT EQUIPMENT SERIES], 1974, No 2.

17. Gololobov V.P., Ishchenko M.G., Tsymbal V.I. Shelamov G.N., TEKHNIKA SREDSTV SVYAZI, SERIYA RADIOIZMERITEL'NAYA TEKHNIKA, 1978, No 6.

18. Bokrinskaya A.A., Tsymbal V.I., Shelamov G.N., "Analiz i inzhernaya realizatsiya sistem funktsional'noy elektroniki SVCHh diapazona" ["The Analysis and Engineering Realizations of Microwave Band Functional Electronics Systems"], Kiev, "Knowl'edge" Society of the UkrSSR, 1979.

19. U.S. Patent No. 3839677, Cl. 325/446 (H04B1/261).

20. USSR Patent No. 677018, "Magnitnaya Sistema" ["A Magnet System"], Bokrinskaya, A.A., Gololobov V.P., Misevich V.I., Tsymbal V.I., Shelamov G.N.



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PUBLICATIONS, INCLUDING COLLECTIONS OF ABSTRACTS

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ANALOG INTEGRATED CIRCUITS

Moscow ANALOGOVYYE INTEGRAL'NYYE MIKROSKHEMY: SPRAVOCHNIK in Russian 1981 (signed to press 11 May 81) pp 2-3, 160

[Annotation, foreword and table of contents from book "Analog Integrated Circuits", by Boris Petrovich Kudryashov, Yuriy Vasilyevich Nazarov, Boris Vladimirovich Tarabrin and Viktor Alekseyevich Ushibyshev, reviewer Candidate of Technical Sciences N. N. Goryunov, Izdatel'stvo "Radio i svyaz'", 300,000 copies, 160 pages]

[Text] General information is given (classification, designations), along with electrical parameters and schematics, of serially produced analog ICs in general use, which are of greatest interest for radio amateurs.

It is intended for a wide range of radio amateurs.

FOREWORD

Microelectronics is intensively penetrating all spheres of the national economy and radio amateur practice. Specialists and radio amateurs alike are convinced that radio electronic equipment and very simple devices based on integrated circuits (IC) combine excellent reliability with small size and weight.

The use of IC's also makes it easier to calculate and design the functional units and blocks of radio electronic equipment. By viewing the IC as a "black box" having certain properties, the equipment designer or radio amateur is freed of the necessity of calculating the IC component conditions; he need only supply the electrical conditions for it stated in the technical specifications to obtain the IC's guaranteed parameters. For this reason, interest in IC's is steadily growing.

The task of this book is to familiarize radio amateurs with the technical data of the most popular classes of analog IC's. In the authors' opinion, these include differential and operational amplifiers, which are very widely used, and high, intermediate and low frequency amplifiers and voltage stabilizers.

As a rule, for each IC in this reference book are given the chassis design, schematic diagram, standard connection circuit, maximum and standard operating conditions, electrical parameters, and graphs of the parameter dependences on modes and conditions of use.

The external elements required for normal IC operation are given with the standard connection circuits, which are one of the variations of the IC's use (generally the main one for differential, HF, IF and LF amplifiers and voltage stabilizers and not the main one for operational amplifiers, since their use without negative feedback is a special case). The electrical parameters of IC's are measured with their connection in a standard circuit according to All-Union State Standard 19799-74 "Integrated Circuits. Methods of Measuring Electrical Parameters and Determining Characteristics."

The maximum operating conditions usually exceed the IC conditions at which its parameters are measured. Irreversible physical changes do not occur given the IC's operation in the maximum conditions, but its electrical parameters in such a case are not standardized by the delivery document. Exceeding the maximum conditions can result in the circuit's failure, accelerated degradation of its parameters or disruption of operation.

With the exception of specified cases, the tables provide for each IC model the worst values of the electrical parameters for the indicated environmental temperature and electrical measurement conditions. For example, $K_{aU} \cdot 10^{3}$ [50] means that all amplifiers of the given model will have a voltage gain greater than or equal to 50,000.

For most IC's, this book gives the standard dependence of electrical parameters on the use conditions and environmental temperature. Except for specified cases, the dependences of electrical parameters on use conditions are given for a normal (25°C) environmental temperature. The IC conditions from which the graphs are taken correspond to those indicated in the electrical parameter tables for the corresponding parameter. When designing functional radio electronic equipment units using IC's, one must use not the standard electrical parameter values, but those guaranteed from the electrical parameter tables.

The use of IC's in an actual device is determined by the degree to which their parameters (electrical and operational) meet the requirements which the equipment places on them.

The authors request that all comments and suggestions for improving this work be sent to: 101000, Moscow, Chistoprudnyy Blvd., Izdatel'stvo "Radio i svyaz'", Popular Radio Library Department.

TABLE OF CONTENTS

9875
CSO: 1860/17

ANNOTATION AND ABSTRACTS FROM THE JOURNAL 'HIGH-VOLTAGE TECHNOLOGY'

Moscow TRUDY MOSKOVSKOGO ORDENA LENINA I ORDENA OKTYABR'SKOY REVOLYUTSII ENERGETICHESKOGO INSTITUTA, TEMATICHESKIY SBORNIK: TEKHNIKA VYSOKIKH NAPRYAZHENIY in Russian No 510, 1981 (signed to press 11 Feb 81) pp 2, 139-144

[Text] This collection reflects the results of investigations and studies regarding the major scientific schools of thought in the department of high-voltage technology: electrical discharges in gases, lightning protection, insulation of high-voltage equipment, overloads in electrical systems, testing and electrophysical equipment, electrostatic technology, state electricity, environmental protection.

This collection is dedicated to the department's 50th anniversary and, therefore, some of the articles are surveys.

The information in this collection can be of interest to a broad circle of readers: scientific workers, engineers and undergraduate and postgraduate students working and specializing in the field of high-voltage technology.

UDC 621.3.01

MAJOR STAGES IN THE DEVELOPMENT OF THE DEPARTMENT OF HIGH-VOLTAGE TECHNOLOGY

[Abstract of article by Larionov, V. P.]

[Text] The major schools of thought in educational and scientific research work are examined at various stages of the department's development. This article characterizes the current content of the "High-Voltage Technology" department. The major achievements of the department's scientific divisions and the problem-solving and specialized laboratories are described.

UDC 621.315.618

AN INVESTIGATION OF ELECTRICAL DISCHARGES IN AIR GAPS

[Abstract of article by Sergeyev, Yu. G., Sokolova, M. V., and Tarasova, T. N.]

[Text] This article provides a brief overview of the basic results of investigations into electrical discharges conducted at the department of High-Voltage Engineering of the Moscow Power Engineering Institute using pulse and high-frequency voltages. It presents the principle of the engineering method for calculating initial voltages.

UDC 551.594:629.735.33

LIGHTNING PARAMETERS AND LIGHTNING PROTECTION

[Abstract of article by Agapov, V. G., Brekhov, V. M., Larionov, V. P. and Sergiyevskaya, I. M.]

The vulnerability of ground objects and aircraft is examined. A method is given for evaluating the reliability of the lightning protection on aircraft and for determining the calculated and test parameters of lightning.

UDC 21.315.62

CALCULATION OF THE ELECTRIC FIELDS OF INSULATION DESIGNS

[Abstract of article by Kolechitskiy, Ye. S., and Moiseyev, V. N.]

[Text] Electric fields of calculated models of insulation designs are examined. A connection is established between the form of the dielectric interface and the distortion of the field calculated in a homogeneous medium. The feasibility of a purposeful selection of the dielectric's form in order to reduce field nonuniformity both in dielectrics as well as on their interface is demonstrated.

UDC 537.533.4.621.315.611.002.25

POWER CHARACTERISTICS OF PARTIAL SURFACE DISCHARGES AND THEIR APPLICATION FOR ESTIMATING THE SERVICE LIFE OF POLYMER INSULATION

[Abstract of article by Aronov, M. A., Ivanov, A. V., and Kokurkin, M. P.]

[Text] The stages and forms of damage to solid polymer insulation due to the effects of partial surface discharges are studied. A criterion is established for the transsition from erosion damage to other types of deterioration. The practicability of utilizing the power characteristics of partial suface discharges to estimate the service life of polymer insulation is demonstrated. A method for speeding up the testing of dielectrics is developed.

UDC 621.313.12:621.315.61.001.5

THE STUDY AND DEVELOPMENT OF ELECTRICAL INSULATION FOR PWERFUL GENERATORS WITH NOMINAL VOLTAGES OF 110 TO 220 kV

[Abstract of article by Kulikov, I. P., Minyayeva, O. V., Mikleyeva, N. V., Pintal', Yu. S., and Plotnikov, Ye. A.]

[Text] This article cites the basic results regarding the creation of electrical insulation for stator windings of high-voltage hydrogenerators with nominal voltages of 110 to 220 kV These studies were conducted from 1965 to 1980 in the Department of High-Voltage Engineering of the Moscow Power Engineering Institute and at the "Uralelektrotyazhmash" [Ural Electrical Heavy Machinery Plant] imeni V. I. Lenin.

UDC 621.315.2.016.2:621.315.614.62.001.5

A STUDY OF ELECTRICAL INSULATION OF POWER CABLES

[Abstract of article by Pintal', Yu. S., and Shakhgedanova, S. M.]

[Text] This article presents the results of an experimental study of the characteristics of initial partial discharges in paper-and-oil insulation of oil-filled cables. It is shown that in the paper-and-oil insulation of oil-filled cables for 110-500 kV networks, initial partial discharges appear at intensities of about 10 kV/mm. For this reason, they can determine the service life of oil-filled cables, particularly the new cables created for networks with a greatly restricted overload level.

UDC 621.372.21

THE INFLUENCE OF ELECTRIC-TRANSMISSION STRUCTURE UPON THE SELECTION OF A METHOD FOR CALCULATING OVERLOADS

[Abstract of article by Bazutkin, V. V., and Dmokhovskaya, L. F.]

[Text] This article presents a comparison of various methods of calculation and shows that standing-wave methods and integral transformations make it possible to detect the effects of various factors upon the amplitudes and forms of overloads.

UDC 621.316.935

AN INVESTIGATION OF THE PULSE CHARACTERISTICS OF LIGHTNING-PROTECTION GROUNDING RODS

[Abstract of article by Ryabkova, Ye. Ya.]

[Text] Methods of calculating the pulse resistance of individual grounding electrodes are pointed out. In order to determine the pulse resistance of complex grounding devices, it is proposed that physical models be employed. Characteristics are cited for a model developed in the department of High-Voltage Engineering of the Moscow Power Engineering Institute.

UDC 629.735:621.316.98

DEVELOPMENT AND STUDY OF HIGH-VOLTAGE TEST-PULSE EQUIPMENT

[Abstract of article by Bizyayev, A. S., Kuzhekin, I. P., Minyayev, Yu. G., Naymark, G. V. and Prokhorov, Ye. N.]

[Text] This article briefly presents information regarding the parameters of current and voltage test pulses. Relations are derived which associate the pulse parameters with parameters of an equivalent circuit for voltage-pulse generators. Descriptions are given of circuits, designs and parameters of voltage and current pulse generators intended to investigate a discharge channel up to 1 m in length and to conduct tests of lightning immunity.

UDC 621.3.014.33.002.614

APPLICATION OF PULSE CURRENTS IN INDUSTRIAL AND ELECTROPHYSICAL EQUIPMENT

[Abstract of article by Avrutskiy, V. A., Borisov, R. K., Budovich, V. L., Kalenikov, A. V., Kiselev, V. Ya., Koshchiyenko, V. N., and Kuzhekin, I. P.]

[Text] This article presents an overview of the work done by the Department of High-Voltage Engineering of the Moscow Power Engineering Institute in the area of the theory and technique of utilizing powerful current pulses and magnetic fields under laboratory conditions and in industry. Formulas are given for calculating the operating conditions of high-voltage pulse equipment.

UDC 621.3.015.001.24

METHODS OF CALCULATING THE FIELD AND BEHAVIOR OF PARTICLES DURING A CORONA DISCHARGE

[Abstract of article by Vereshchagin, I. P., and Morozov, V. S.]

[Text] This article examines the analytical and numerical methods of calculating the field of a unipolar corona discharge, widely used in electrical equipment.

Approximated analytical methods of calculation are developed for two-dimensional fields. The article examines features of the field calculation for corona-forming electrodes with a varying radius of curve. It presents a method for calculating the orientation and movement of particles in the electrical field of a corona discharge based on the actual form of the particles.

UDC 621.359.48.662.96

PROCESSES IN ELECTROFILTERS USED TO PURIFY DUSTY GASES

[Abstract of article by Mirzabekyan, G. Z., and Makal'skiy, L. M.]

[Text] This article presents the results of research into the processes that occur in the active portion of an electrofilter. Methods of calculation are suggested which make it possible to determine the degree of purification of the gas in electrofilters with small and large input concentrations of a disperse phase. Relationships are cited which determine the values of the concentration, starting with which it is necessary to consider the effect of the disperse phase on the process of particle capture. The calculated methods give results that agree well with the experiment. Recommendations are given for intensifying the purification process which can be carried out on industrial equipment.

UDC 621.359.7 575/576.001.5

ELECTRICAL PROCESSES DURING THE PRODUCTION OF A CHARGED AEROSOL

[Abstract of article by Vereshchagin, I. P., Makal'skiy, L. M., and Mirzabekyan, G. Z.]

[Text] An analysis is presented of the possible processes of particle charging during the formation of a charged aerosol, chief among which are the charging in a corona-discharge field and induction charging during the break-up of drops in an electrical field. It is established that with the condensation formation of an aerosol in the presence of charged ions of steam, there takes place the diffusion charging of aerosol particles outside of the discharge gap.

An analysis is conducted of the phenomena at the output of the charged-aerosol generator. It is established that with a 40-50 μA aerosol charge transfer each second, discharge phenomena appear in the initial portion of the charged stream. It is shown that the condensation and evaporation of drops of liquid in the charged stream influence the processes of charge transfer.

UDC 667.644.3:621.319.7

PHYSICAL PROCESSES AND EQUIPMENT FOR APPLYING A POLYMER COATING IN AN ELECTRICAL FIELD

[Abstract of article by Pashin, M. M.]

[Text] This article examines the processes of charging particles of powdered polymer materials in electropneumatic sprayers and in a fluidized layer with the application of an electrical field. In the latter case, charging takes place in the field of a corona discharge. The considerable role of the field of the bulk charge of the particles of the material in the deposition process is shown. A method is presented for matching the characteristics of the high-voltage power source which insures the maximum safety of servicing.

UDC 537.222.2.001.5

STATIC ELECTRIFICATION AND NEUTRALIZATION OF CHARGES IN LIQUIDS TRANSPORTED BY PIPES

[Abstract of article by Maksimov, B. K., Obukh, A. A., and Tikhonov, A. V.]

[Text] This article cites the results of research into the electrification of white oils during their charging in pipelines and railroad tank cars.

A method is developed for determining safe conditions for filling tank cars and the maximum permissible speed for pumping petroleum products at an automated pumping station is established. An arrangement is suggested for the automatic control of the operational mode based on a sensor to monitor charge density which was developed for this purpose.



9512
CSO: 1860/25

ANNOTATION AND ABSTRACTS FROM COLLECTION 'IMPROVING TRACTIONAL ELECTRIC-DRIVE AND POWERSUPPLY SYSTEMS'

Moscow TRUDY MOSKOVSKOGO ORDENA LENINA I ORDENA OKTYABR'SKOY REVOLYUTSII ENERGETICHESKOGO INSTITUTA, TEMATICHESKIY SBORNIK: SOVERSHENSTVOVANIYE SISTEM TYAGOVOGO ELEKTROPRIVODA I ELEKTROSNABZHENIYA in Russian No 493, 1980 (signed to press 11 Dec 80) pp 2, 169-179

[Text] This topical collection includes articles written by staff members and graduate students in the department of electrical transport using the results of a scientific examination of tractional electric-drive and power-supply systems for various types of rolling stock for trunkline and urban electric transport.

This collection is of interest to scientific workers and engineers engaged in matters relating to tractional electric drive and power supply.

UDC 621.336.001

EXAMINATION OF THE RELIABILITY AND STABILITY OF FIBERGLASS TROLLEY BOOMS

[Abstract of article by Yefremov, I. S., Isayev, I. P., Savina, T. I., Matveyevich, A. P., Puzankov, A. D., and Kozlov, L. G.]

[Text] Criteria are established for evaluating the fatigue strength of fiberglass booms of a trolley bus current collector. A description is given of a vibration test bench based on the electromagnetic principle and results of fatigue-strength tests of booms are presented.

The article suggests expressions for determining the service life of the booms based on results of the tests.

UDC 621.335:658.562.001.5

AN EXPERIMENTAL TESTING UNIT FOR TROLLEY BUS DIAGNOSTICS

[Abstract of article by Aksenov, N. D., Ozhigin, V. P., Sevost'yanov, A. M., and Stremovskaya, G. P.]

[Text] This article describes the design of an experimental testing unit for comprehensive trolley bus diagnostics. The construction and operational principles of the testing unit's individual assemblies and hardware are examined.

UDC 629.113.6.629.119

AN APPARATUS FOR REMOTE CONTROL OF A TROLLEY BUS ON AN EXPERIMENTAL DIAGNOSTIC UNIT

[Abstract of article by Ozhigin, V. P., Kalashnikov, B. G., Arshinov, S. A., and Prokudin, V. F.]

[Text] This article substantiates the necessity of creating an apparatus for remote control of a trolley bus on an experimental testing unit. Specifications for the apparatus are drawn up. A description is presented of the apparatus's design and electrical circuitry.

UDC 629.113.62:658.56

A METHOD FOR RAPID DETECTION OF FAULTS IN THE CONTROL CIRCUITS OF A ZIU-9B TROLLEY BUS

[Abstract of article by Arshinov, S. A.]

[Text] This article examines and analyzes the methods for rapid detection of faults in the control circuits of a ZIU-9B trolley bus. A method is suggested for rapid detection of faults in the trolley bus's control circuits using a logic circuit.

UDC 629.113.6:629.119

PRINCIPLES OF CONSTRUCTING DIAGNOSTIC EQUIPMENT FOR THE CONTROL SYSTEM OF A TROLLEY BUS'S THYRISTOR PULSE VOLTAGE REGULATOR

[Abstract of article by Glushenkov, V. A.]

[Text] This article examines the principles of constructing diagnostic equipment for the control system of a trolley bus's thyristor pulse voltage regulator. These principles make it possible to quickly detect a malfunctioning assembly at the replaceable circuit board level. On the basis of the analysis of the flow sheet of the system, a schematic is developed for an automated control system.

UDC 629.113.6:629.119

A PULSE SELECTOR FOR DIAGNOSIS OF THE ELECTRONIC CONTROL UNIT OF A RVZ-7 TROLLEY CAR

[Abstract of article by Nikolayev, V. F.]

[Text] This article examines the circuit for a pulse-duration selector constructed on the basis of integrated microcircuits. Time diagrams are presented for the circuits major points. The application of the selector in diagnostic systems is recommended.

UDC 621.335.-621.314

AN ANALYSIS OF THE DYNAMIC PROCESSES IN CLOSED SYSTEMS OF THYRISTOR PULSE-WIDTH REGULATION

[Abstract of article by Komarov, V. G.]

[Text] This article examines a systèm of thyristor pulse-width regulation and its characteristics as a nonlinear pulse system. Based on the actual structure of a pulse-width modulator, an analytical expression is derived which describes the dynamic process of modulation and which establishes the physical essence of dynamic distortion in pulse-width modulators. The influence of these dynamic distortions in open and closed systems is analyzed.

UDC 621.382.2.072:629.113.014

A STABILIZED LOW-VOLTAGE POWER SOURCE FOR A TRAM CAR ELECTRONIC CONTROL UNIT WITH A THYRISTOR-PULSE SYSTEM OF REGULATION

[Abstract of article by Kos'kin, O. A., and Suslov, B. Ye.]

[Text] This article examines a stabilized low-voltage power source consisting of a pulse voltage stabilizer, a control circuit for the stabilizer's power transistor made from a unijunction transistor, a fixed-voltage converter with an automatic-start circuit and a unit for protecting the transistor of the current regulator.

UDC 621.382.2.072:629.113.014

A DEVICE FOR DEFINING THE CURRENT SETTING IN A TRACTIONAL ELECTRIC DRIVE

[Abstract of article by Suslov, B. Ye., and Kryuchkov, A. A.]

[Text] This article examines a contactless device for defining current setting which consists of a voltage sensor, a rotating transformer and two operational amplifiers turned on through a circuit of a comparator with positive feedback and an integrator.

UDC 621.337.5.2:621.382.8

A TIME-TO-PULSE BRAKING-POWER SENSOR

[Abstract of article by Kiryukhin, Yu. A., and Guyber, O.]

[Text] This article examines a microelectronic-based computer for calculating braking power. The computer has enhanced stability of its characteristics due to the introduction of negative feedback into the circuit. The computer is intended for use in automatic electric-braking control systems for electric drives.

UDC 621.314.57:621.335.42

A STATIC CONVERTER FOR SUBWAYS

[Abstract of article by Krasnov, V. F., Marchenko,v, A. P., and Lisin, A. V.]

[Text] This article examines a static converter for supplying the excitation windings of subway car traction motors.

The static converter is designed to supply the excitation windings of subway car traction motors with regulated direct-current voltage and is configured with an independent parallel inverter to whose output are connected regulated thyristor rectifiers. The article examines the operational characteristics of the static converter under subway conditions. These characteristics determine the selection of the schematic and the parameters of individual elements. A test model of the static converter proved reliable during test runs on a YeZh-type car. Experimental load characteristics and diagrams of the static converter's working process are presented.

UDC 621.337-52.001.5

A DIGITAL CONTROL SYSTEM FOR A THYRISTOR CONVERTER WITH INDUCED COMMUTATION FOR AN ALTERNATING-CURRENT ELECTRIC TRAIN

[Abstract of article by Trakhtman, L. M., Karpov, Yu. A., and Starodumov, V. S.]

[Text] This article presents specifications for a system intended to generate control pulses for a thyristor rectifier-inverter converter with enhanced power characteristics. Control of the converter requires four pulses during each half-cycle of the circuit voltage. The phase angle of these pulses depends upon the mode of operation (tractive or braking) and the magnitude of the load current (working or pulse). A block diagram is presented and the operation of the control system is described. This system is based on a digital principle of time-interval assignment which insures the temperature stability of the phase angles of pulse delivery under the indicated operational modes.

UDC 629.423.31:621.314.6

A ROTOR-POSITION AND ROTATIONAL-FREQUENCY VARIABLE-RELUCTANCE PICKUP FOR A THYRATRON MOTOR

[Abstract of article by Tulupov, V. D., and Kovalev, Yu. I.]

[Text] Results are presented from the development of a rotor-position variable-reluctance pickup based on a self-oscillator with sequential shift of position and negative feedback with respect to alternating current.

A block diagram is presented for a digital rotational-frequency sensor for thyratron motors. This sensor utilizes information obtained from the output of the rotor-position pickup.

UDC 621.337-52.001.5

A CONTROL-SIGNAL COMMUTATOR FOR AN AUTOMATIC CONTROL SYSTEM OF AN AC ELECTRIC TRAIN WITH SEPARATE EXCITATION OF THE TRACTION MOTORS

[Abstract of article by Panov, V. F.]

[Text] This article proposes a system of automatic tractive-free control for an AC electric train with separate excitation of the traction motors. It examines a method of switching from voltage to current regulation of traction-motor excitation. It describes a block diagram that provides for this transition (a control-signal commutator) and the processes that arise in this case.

UDC 621.3.017.8

POWER INDICATORS OF PULSE-FREQUENCY REGULATION ON AN ELECTRIC TRAIN

[Abstract of article by Bure. I. G., Khevsuriany, I. M., and Shevchenko, V. V.]

[Text] This article presents the results of tractive power testing of an electric train at a voltage of 6 kV DC with pulse-frequency voltage regulation of the traction motors and with the train's internal needs being supplied from a static thyristor converter. A comparison is made of the experimental and calculated power indicators of electric rolling stock in traditional and regenerative-braking modes.

UDC 621.335:621.314.6.57

SUITABILITY OF APPLICATION OF A STATIC THYRISTOR CONVERTER FOR SUPPLYING THE INTERNAL NEEDS OF AN ER-2 ELECTRIC TRAIN

[Abstract of article by Bayryyeva, L. S., and Shevchenko, V. V.]

[Text] This article examines the suitability of using static thyristor converters to replace electromechanical converters to supply the internal needs of an ER-2 electric train. A converter layout is suggested based on an inverter with two commutator circuits. The article examines the operation of this converter under various types of operation and compares the converters with respect to power and dimensional indicators.

UDC 621.316.72

TRANSIENT CHARACTERISTICS OF DC ELECTRIC TRACTION MOTORS SUPPLIED BY A PULSE-FREQUENCY CONVERTER

[Abstract of article by Bayryyeva, L. S.]

[Text] As a result of calculations applied to URT-110A and DPE-400 traction motors and the parameters of pulse-frequency converters installed on rolling stock, it is shown that there is a reduction in current surges which arise during supply-voltage differences. These surges are reduced by more than a factor of two in comparison with the standard supply system. Results of experimental testing are cited.

UDC 621.314.6

A STUDY OF RECTIFIERS IN A HEAVY-DUTY SEMIREGULATED BRIDGE-TYPE RECTIFIER ASSEMBLY

[Abstract of article by Arzamastsev, N. V.]

[Text] This article examines the operational characteristics of diodes and thyristors in a heavy-duty regulated bridge-type rectifier connected at the output of a static converter. It presents a method of determining losses in the rectifiers of a bridge-type rectifier assembly and provides recommendations for reducing these losses. It also gives the results of experimental testing of a 150-kW static converter on a VL-II-001 electric train.

UDC 621.314:681.335.7

A STUDY OF AN INTEGRATED MICROCIRCUIT CONTROL SYSTEM FOR AN ELECTRIC TRAIN WITH PULSE REGULATION

[Abstract of article by Bederova, A. N., and Kukushkin, S. P.]

[Text] This article presents results from the construction of an integrated microcircuit control system for thyristor converters on electric rolling stock with pulse regulation. It provides the foundation for selecting the elementary basis for the development of integrated microcircuit control systems and an evaluation of their reliability.

UDC 621.335.42

A POWER-CIRCUIT LAYOUT FOR SUBWAY CARS WITH REGENERATIVE-RESISTOR BRAKING

[Abstract of article by Tulupov, V. D., Marchenkov, A. P., and Lyapunova, N. D.]

[Text] This article examines the feasibility of re-equipping mass-produced subway cars with a separate automatic system of regulated excitation of the traction motors. The primary advantage of this system is the energy saving (about 30 percent) due to the application of regenerative braking despite the presence of ballistic resistors in the armature circuits, included for maintaining a high braking effect. Purely resistive braking remains as substitute braking at low speeds and in case of accident. The article presents an arrangement of subway-car power circuits which realizes the tractional mode of operation as well as the regenerative and rheostatic braking.

UDC 621.313.339

FEATURES OF SELECTING THE CAPACITANCE VALUE OF A FILTER IN A TRACTION DRIVE WITH ASYNCHRONOUS MOTORS AND WITH PARALLEL CONNECTION OF FREQUENCY CONVERTERS

[Abstract of article by Stepanov, A. D., Anders, V. I., Bogatin, A. A., Kolobov, M. G., and Ivanov, V. I.]

[Text] Basic relationships are presented for the selection of capacitance for a frequency-converter filter. In selecting the filter capacitance, the parallel operation of several frequency converters upon it is taken into consideration.

UDC 621.335.5

PRINCIPLES OF CONTROLLING MOTORS WITH SEPARATE EXCITATION FOR INDIVIDUAL DRIVE-WHEEL TRACTIONAL EQUIPMENT

[Abstract of article by Ustinov, A. V., Zykov, Yu. A., and Shadrin, V. A.]

[Text] Examined are questions of control of DC motors with separate excitation in the presence of individual excitation regulators and series connection of motors when there are a great many drive wheels. Recommendations are provided for constructing a system of automatic excitation regulation during tractional and braking operation. An alternative for the schematic of such a system is suggested which is configured using integrated microcircuits.

UDC 625.282-681.325.6

A METHOD OF SYNTHESIZING LOGIC DEVICES WITH REPEATED CYCLICAL VARIATION OF THE INPUT VARIABLES

[Abstract of article by Nabebin, A. A., and Prechisskiy, V. A.]

[Text] This article examines a method of synthesizing logic circuits whose graph-scheme is represented by many identical cycles of variables, based on the example of a device for switching poles in the AC electric transmission of a self-contained locomotive.

UDC 621.335.2

TECHNICAL AND ECONOMIC ASPECTS OF THE APPLICATION OF AC ELECTRIC TRANSMISSIONS WITHOUT INTERMEDIATE CONVERTERS IN SELF-CONTAINED LOCOMOTIVES

[Abstract of article by Prechisskiy, V. A., Novikov, V. A., Chernyshov, V. A., Trofimenko, V. I., and Barten'yev, O. V.]

[Text] This article cites the results of technical and economic calculations which point out the suitability of utilizing an electrical transmission with commutatorless AC motors without intermediate converters in self-contained locomotives, particularly in those with multishaft gas-turbine engines.

UDC 629.414.1:621.436-61.004.18

ENERGETICS OF SHUNTING OPERATIONS AND THE PROSPECT OF REGENERATION FOR DIESEL SHUNT LOCOMOTIVES

[Abstract of article by Boldov, N. A., and Bkhatt, D. P.]

[Text] This article shows the suitability and practicability of utilizing regenerative braking on diesel shunt locomotives and presents the basic circuit arrangements for and characteristics of regeneration. It evaluates the efficiency of regenerative layouts which result in improved shunting operation with a simultaneous reduction in fuel losses and brake-block replacement, as well as a reduction in pollution of the environment.

UDC 621.313.13

ON THE SELECTION OF LIGHT-DUTY TRACTION MOTORS

[Abstract of article by Stepanov, A. D., Anders, V. I., Boldov, A. N., and Safronov, A. V.]

[Text] An analysis is made of existing motor designs from the standpoint of their utilization as traction motors in transportation equipment. The motors are compared with respect to the active-surface utilization factor.

UDC 621.316:632.001.5

EFFECT OF TRACTION LOAD ON THE SERVICE LIFE OF RECTIFIERS OPERATING IN RECTIFYING ACTION SUBSTATIONS OF STREET CARS AND TROLLEY BUSES

[Abstract of article by Yefremov, I. S., and Kalashnikov, B. G.]

[Text] This article presents a method for evaluating the effect of a cyclical traction load on fatigue deterioration of semiconductor power rectifiers operating in converter substations of street cars and trolley buses. Results are cited for the deterioration of silicon power rectifiers in street car and trolley bus substations.

UDC 621.331:621.311.031

A STUDY OF THE POWER CHARACTERISTICS OF A TRACTION-DRIVE SYSTEM FOR HIGH-SPEED SURFACE TRANSPORTATION

[Abstract of article by Dolaberidze, G. P., and Stroyev, V. P.]

[Text] This article examines an algorithm for designing a power-supply system for high-speed surface transportation on magnetic suspension with linear synchronous traction motors. Values for the supply voltage, the power factor and the efficiency of the system are found for the various lengths of the winding sections in the active motive structure depending upon the motor's excitation current.

UDC 621.331.021.516.93:621.314.5

A STANDARDIZED CONVERTER UNIT FOR STATE ELECTRICAL TRUST SUBSTATIONS

[Abstract of article by Zagaynov, N. A., Chibisov, A. N., Osipov, V. Ye., and Maksimova, L. A.]

[Text] This article examines a unit designed to supply a State Electrical Trust contact system in decentralized as well as centralized supply systems. Systems are described for the control and protection of the unit under emergency conditions. An analysis is made of the electromagnetic processes arising during external shorting of the rectifier with respect to the zero supply circuit. A calculation is made of the dependence of short-circuit current peaks upon the length of the supply cable.

UDC 621.314.5-714:621.382.026

AN INVESTIGATION OF THE INFLUENCE OF DESIGNS FOR A THYRISTOR CONVERTER WITH NATURAL AIR COOLING UPON THE THERMAL CHARACTERISTICS OF POWER THYRISTORS

[Abstract of article by Nikol'skiy, I. K.]

[Text] Results are cited of experimental studies of the effect of the design for a rectifier case upon the steady-state heating of a T630 thyristor body with an OA-032 cooler when a single power unit and three SPP's [power semiconductor device] are situated in the compartment.



9512
CSO: 1860/23

ANNOTATION AND ABSTRACTS FROM JOURNAL 'METHODS AND DEVICES FOR PRODUCING AND PROCESSING RADIO SIGNALS'

Moscow TRUDY MOSKOVSKOGO ORDENA LENINA I ORDENA OKTYABR'SKOY REVOLYUTSII ENERGETICHESKOGO INSTITUTA, TEMATICHESKIY SBORNIK: METODY I USTROYSTVA FORMIROVANIYA I OBRABOTKI RADIOSIGNALOV in Russian No 463, 1980 (signed to press 22 Jan 80) pp 2, 101-107

[Text] The articles in this collection are devoted to the pressing theoretical and practical questions of the production and processing of signals in various types of radio equipment. A number of articles analyze the principles of construction of precision phase-locking communication systems. They also examine problems of increasing the quality of signals with phase and frequency modulation. Considerable attention is devoted to the study of methods for improving the quality characteristics of signal-processing equipment. Questions are examined regarding the determination of the structure and parameters of the optimum analog and digital filters for extracting a legitimate signal. The results of research into the performance of data systems in terms of error probability are cited. The articles examine methods for improving the quality of equipment intended for the reception and processing of optical signals as well as of transistor amplifiers and active filters.

This collection can be useful for specialists working in the area of radio-receiver and radio-transmitter technology.

UDC 621.391.535

THE STRUCTURE OF RADIO SIGNALS MATCHED WITH LINE FILTERS

[Abstract of article by Sudakov, S. S.]

[Text] A random linear radio circuit is examined as a matched filter for specific radio signals. A structure is found for radio signals which are matched with: 1) a parallel oscillatory circuit; 2) a balancing mixer loaded on an oscillatory circuit; 3) a superheterodyne receiver with a radio-frequency amplifier; 4) a superheterodyne receiver with double frequency conversion.

UDC 621.391.82

STATISTICAL CHARACTERISTICS OF A DATA SYSTEM WITH FEEDBACK

[Abstract of article by Bystrov, S. T.]

[Text] This article describes a data system with feedback in which, during the data-transmission process, a change in the amplification factor of the transceiving section is achieved by means of the introduction into the system of a parametric multiplier with dependent pumping. It is shown that the introduction of this element into the system makes it possible to achieve a given probability of error and accurate data transmission with lower gains in the data channel than in a system without dependent pumping.

UDC 621.398.505

DIGITAL KALMAN FILTER FOR A SIGNAL IN THE FORM OF A QUADRATIC POLYNOMIAL

[Abstract of article by Denisov, S. A., and Rakov, V. K.]

[Text] This article examines the construction of a transient digital filter which, in an optimal fashion, separates a legitimate signal in the form of a quadratic polynomial with random coefficients from a blend of the signal with noise. The method of construction consists of synthesizing an analog filter prototype which solves a given problem in continuous time and of making a subsequent transition using one of the known methods to a digital filter. The feasibility of constructing such a filter using microprocessors of various word length is evaluated.

UDC 621.391.82

SENSITIVITY OF A DATA SYSTEM WITH FEEDBACK

[Abstract of article by Botnev, V. N., and Grusha, S. A.]

[Text] This article examines a data system with feedback in which the transmitter, oscillation-propogation medium, receiver and non-noisy feedback channel form a closed dynamic system, since it is possible to establish either a self-excitation or a damped-oscillation mode in it. It is shown that the sensitivity of the system under investigation is close to the sensitivity of a system with phase modulation but, in contrast to the latter, does not require phase locking.

UDC 621.396.962.2

EVALUATING THE EFFECTIVENESS OF PASSIVE-NOISE SUPPRESSION

[Abstract of article by Razgonyayev, Yu. V.]

[Text] This article analyzes the effectiveness of application of moving-target selection using continuous-radiation Doppler radar with coherent analog accumulation. It is shown that the introduction of such an indication in the presence of intense passive interference with a symmetrical power spectrum gives a 3 dB gain in the threshhold signal in comparison with a receiver without selection.

UDC 621.383:535.241:778.35.03

ON THE EQUIVALENCY OF FREQUENCY AND SPATIAL-FREQUENCY FILTRATION IN OPTICO-ELECTRONIC ANALYZERS

[Abstract of article by Blagorodov, A. M., Vanetsian, R. A., Danilov, B. V., Sharov, Yu. V. and Shtykhno, V. V.]

[Text] A noncoherent optical correlator (NOK) is examined from the standpoint of the phenomenon of spatial resonance. It is shown that with the help of filtration of the output power signal of the NOK, an equivalent transformation of the spectrum of spatial frequencies of the output image can be carried out. The article cites the results of a computer calculation of the weighted spectral harmonic coefficients of the output signal.

UDC 621.391.822.01:621.396.621.2:621.396.232

ON THE NOISE FACTOR OF THE LINEAR SECTION OF A RADIO RECEIVER WITH A SEMICONDUCTOR-DIODE DETECTOR

[Abstract of article by Osipov, Ye. Ye.]

[Text] On the basis of an analysis of the coherence of high-frequency noise at the p-n junction of a semiconductor diode operating as an HF detector in a radio receiver, high-frequency noise reflected from the input of the detector and high-frequency noise arriving at the input of the radio receiver, an expression is derived for the noise factor in the HF section of the radio receiver with respect to the output passed to the p-n junction of the detector diode. Conditions are determined under which this noise factor can be replaced with a known noise factor with respect to the output reflected from the input of the HF detector.

UDC 621.354.76

TRANSFORMATION OF T-SYSTEM NOISE PARAMETERS USING LINEAR UHF QUADRIPOLES

[Abstract of article by Kurushin, A. A., and Tekshev, V. B.]

[Text] Relationships are presented for calculating the primary noise parameters in a T-system of various connections for two noisy quadripoles: parallel, series and cascade. This article examines the influence of external feedback on the transmitting and noise characteristics of microwave transistors.

UDC 621.375.4(088.8)(520)

MINIMIZING NONLINEAR DISTORTION IN TRANSISTOR AMPLIFIERS

[Abstract of article by Bogatyrev, Ye. A., and Grebenko, Yu. A.]

[Text] This article examines the question of reducing nonlinear distortion in transistor amplifiers. In order to describe the nonlinear properties of amplifiers, an apparatus of functional Volterra series is used. The following procedure is suggested for synthesizing a highly linear amplifier: 1) the development of base amplifier modules which describe a functional Volterra series with a zero kernel of the second order; 2) the synthesis of a block diagram for connecting amplifier modules which describes a functional Volterra series with a zero kernel of the third order.

UDC 621.372.54

NOISE CHARACTERISTICS OF ACTIVE RESISTIVE-CAPACITIVE FILTERS OF THE SECOND ORDER

[Abstract of article by Kapustyan, V. I.]

[Text] This article compares the noise characteristics of certain second-order circuits which have received the broadest practical application. The calculated relationships derived are presented in a form convenient for engineering calculations. Methods are determined for expanding the dynamic range of the circuits examined.

UDC 621.373.52.001

INFLUENCE OF DUTY LOAD ON THE SYNCHRONIZATION BAND OF SELF-EXCITED TRANSISTOR OSCILLATORS

[Abstract of article by Artemenkov, S. L., Samoylenko, O. I., and Smol'skiy, S. M.]

[Text] With the help of calculations made on a digital computer, the influence of a transistor's duty load on the size of a self-excited oscillator's synchronization band is analyzed. The analysis was carried out for a piecewise model of an active element. This article examines the behavior of resonance characteristics and the local stability of steady-state synchronous modes of self-excited oscillators. It examines the influence of certain parameters of synchronized self-excited oscillators on their synchronous band.

UDC 621.373.121.11; 621.376.32

PARASITIC AMPLITUDE MODULATION WITH FREQUENCY MODULATION OF OSCILLATIONS OF SINGLE-CIRCUIT OSCILLATORS

[Abstract of article by Laut, L. N.]

[Text] The "abbreviated" differential equations derived earlier for single-circuit generators of frequency-modulated oscillations are solved together with the equation for the bias circuit. The active element is treated as inertialess. Using the expressions derived for the variable components of the amplitude of the oscillations, the article examines the influence of the bias circuit parameters on the parasitic amplitude modulation.

UDC 621.374.4

BAND CHARACTERISTICS OF SINGLE-CIRCUIT VARACTOR FREQUENCY DIVIDERS

[Abstract of article by Ob"yedkov, A. F., and Turkin, A. A.]

[Text] This article presents an accurate method for determining the separation band of varactor frequency dividers with a piecewise characteristic.

The article examines circuits with external and automatic bias. The dependence of the separation bandwidth upon the magnitude of the bias and the resistance of the autobias with various dampings in the circuit are derived.

UDC 621.397

ON CALCULATING THE INTERCOUPLINGS IN THE SIMPLEST ACTIVE PHASED ANTENNA ARRAYS

[Abstract of article by Bikmurzin, R. S., Dvornikov, A. A., and Chukov, A. M.]

[Text] This article examines the influence of intercouplings on the operation of an active two-element phased antenna array in which self-exciting oscillators or regenerative amplifiers are used as active modules. It demonstrates the feasibility of narrowing the band of external synchronization of active self-exciting oscillator modules. The article also points out the occurrence of instability in the operation of active regenerative-amplifier modules.

UDC 621.373.8

CHARACTERISTICS OF MODELING TRANSIENTS IN LASERS USING ELECTRONIC ANALOG COMPUTERS

[Abstract of article by Il'in, Yu. B., and Konstantinov, V. H.]

[Text] This article examines the types of and reasons for instability in the operation of a laser model composed of a MN-18 analog computer using Statz-DeMars equations in accordance with the standard methodology. By means of a qualitative analysis of the model's phase plane, the article demonstrates the deciding role of fluctuations in the machine variables and the error in the polygonal approximation of the integration operation of the multiplication block in the formation of instability effects.

UDC 621.317.7

MULTIDIMENSIONAL INTERCOUPLED PHASE AUTOALIGNING SYSTEMS WITH SIGNAL-FREQUENCY CONVERTERS

[Abstract of article by Kapranov, M. V.]

[Text] Matrix differential equations are derived for multidimensional interconnected phase autoaligning systems of random structure with frequency conversion of many external signals. This article also examines frequency-conversion matrices for various methods of organizing the partial rings into an interacting collective.

UDC 621.373.078.6.001

TRACKING PHASE AUTOALIGNMENT WITH INTEGRATED CONTROL

[Abstract of article by Kurochkina, T. I.]

[Text] This article examines the feasibility of utilizing a system of phase autoalignment of frequency with integrated control based on frequency-phase autoalignment in order to track the linearly varying frequency of a signal. This article determines the dependence of the critical rate of tracking and the noise band upon the parameters of such a system. It also uses these indicators to compare a phase autoaligning system having integrated control with a phase autotuning system having an ideal proportional integrating filter.

UDC 621.396.2

AN ANALYSIS OF THE STABILITY OF A MUTUAL-SYNCHRONIZATION SYSTEM WITH TWO SPATIALLY SEPARATED SELF-EXCITING OSCILLATORS

[Abstract of article by Getta, T. G.]

[Text] The phase-plane method is used to investigate the stability of a large mutual synchronization system of two spatially separated self-exciting generators. Cutoff points are determined for the occurrence of synchronous, quasi-synchronous and asynchronous operation depending upon time delays in the communication channel.

UDC 621.396.96

SYNTHESIS OF A FILTER IN A SYSTEM FOR AUTOMATIC CORRECTION OF REGULAR DISTORTION OF A LINEAR-FREQUENCY MODULATED SIGNAL

[Abstract of article by Belov, L. A.]

[Text] This article presents a synthesis of several filter variants in a feedback circuit of a system for autoalignment of regular distortion in a linear-frequency modulated signal formed after the feedback circuit. A calculation is made of the errors between cadence points and their dispersion with various system parameters.

UDC 621.396.96

DISTORTION OF WIDEBAND SIGNALS WITH LINEAR FREQUENCY MODULATION IN PHASED ANTENNA ARRAYS

[Abstract of article by Tomskiy, A. M.]

[Text] This article examines the reasons for distortion of wideband signals with linear frequency modulation when passing through a phased antenna array. An expression is presented which describes the form of the signal's linear-frequency modulation envelope after passage through a phased antenna array, and results are cited for the calculation of the signal's linear-frequency modulation envelope with various angles of reception of the signal by the phased antenna array.



9512
CSO: 1860/22

ANNOTATION AND ABSTRACTS FROM COLLECTION 'METHODS AND MEANS FOR OPTIMIZATION OF ELECTROMECHANICAL ELEMENTS AND SYSTEMS'

Moscow TRUDY MOSKOVSKOGO ORDENA LENINA I ORDENA OKTYABR'SKOY REVOLYUTSII ENERGETICHESKOGO INSTITUTA, TEMATICHESKIY SBORNIK: METODY I SREDSTVA OPTIMIZATSII ELEKTROMEKHANICHESKIKH ELEMENTOV I SISTEM in Russian No 500, 1980 (signed to press 29 Jan 81) pp 2, 129-136

[Text] This collection reflects the new directions in research on electric drives, electrical machinery and electrical devices. The articles present new methods for the study and optimization of electromechanical elements and systems.

A great many of the articles are devoted to discrete drives which have received broad application in the USSR and abroad in various automated systems. This collection presents the results of studies which have considerable economic significance.

Questions are examined regarding the construction of optimal systems for robots and manipulators as well as regarding the optimal design of electrical machinery. Also studied are features of the dialog method of solving design problems which makes it possible to effectively carry out the design of electromechanical devices and equipment as well as a number of pressing questions regarding the building of such apparatus.

This collection is intended for engineers engaged in the development and operation of automated electric drives, their elements and the automatic systems in which the given drives are employed. The collection can also be useful for undergraduate and postgraduate students in the corresponding specialities.

UDC 621.313.323-133.22

A POWER MODEL OF SINGLE-PHASE STEP MOTORS AND A STUDY OF QUASI-STATIC MODES OF OPERATION

[Abstract of article by Kulevokaya, Ye. F.]

[Text] Quasi-static step modes are analytically examined on a power model of a single-phase step motor. As a result of an examination of the operational control over excess-energy and metered pulses, it is shown that the best motive performance and highest efficiency with control of excess-energy pulses is had by motors with a great many working harmonics which insure a high coefficient of nonsymmetry for the angular momentum characteristics. With control of the metered pulses, the best indicators are had by motors with two working harmonics.

UDC 621.313-133.22

METHODS FOR IMPROVING THE MOTIVE PERFORMANCE FOR QUASI-STATIC STEP OPERATION OF SINGLE-PHASE STEP MOTORS

[Abstract of article by Kuznetsova, O. M.]

[Text] This article examines certain questions regarding the elimination of speed fluctuations in single-phase step motors whose fixing moment has the same periodicity as an electromagnetic motor. A mathematical expression is presented for determining the time of movement of the rotor in such a motor with start-stop control.

UDC 62-83:621.313.13-133.4

A STUDY OF THE OPERATION OF A SINGLE-PHASE STEP MOTOR WITH SINGLE-POLE CONTROL IN THE AUTOSWITCHING MODE, BASED ON A MATHEMATICAL MODEL

[Abstract of article by Obukhov, N. A.]

[Text] This article examines the high-frequency operating conditions for a single-phase step motor with single-pole control and which is closed with respect to the rotor position. Step-motor characteristics are presented in polynomial form.

UDC 621.313.13-133.3.001.33

A COMPARATIVE ANALYSIS OF INDUCTIVE AND CAPACITIVE STEP MOTORS WITH GAS SUPPORTS

[Abstract of article by Kopylov, A. I.]

[Text] This article compares the maximum specific forces developed by inductive and capacitive step motors having two versions of geometrical configuration for the toothed area. It demonstrates the feasibility of utilizing capacitive plane step motors with gas supports in precision-positioning systems.

UDC 621.313.323-133.22

ELECTROMAGNETIC FORCE OF A LINEAR PERMANENT-MAGNET MOTOR

[Abstract of article by Moshchinskiy, Yu. A., and Kiryakin, A. A.]

[Text] This article derives an expression for the force of a linear step-type permanent-magnet electric motor based on the magnetic resistance of the permanent magnets. An expression is derived for the maximum force.

UDC 621.313.323-133.32

DYNAMIC EQUATIONS OF A TWO-COORDINATE STEP MOTOR

[Abstract of article by Moshchinskiy, Yu. A., and Kopylov, A. I.]

[Text] This article derives general dynamic equations for a two-coordinate step motor based on dynamic equations for a free rigid body.

UDC 621.313.17

MODEL OF AN AUTOMATIC POWER REGULATOR FOR CALCULATING THE CHARACTERISTICS OF AN ASYNCHRONOUS MOTOR IN THE DIALOG MODE

[Abstract of article by Dmitriyev, M. M., and Kuznetsov, N. L.]

[Text] A model is suggested for an automatic power regulator which makes it possible to study the characteristics of asynchronous motors under transient and steady-state operating conditions. It also makes it possible to derive polynomial relationships between the parameters of asynchronous motors using methods of planned experiment and to obtain series 4A scale-less drawings.

UDC 621.313.323-133.22

METHODS OF IMPROVING THE MOTIVE CHARACTERISTICS OF SINGLE-PHASE HARMONIC STEP MOTORS IN STEADY-STATE OPERATION

[Abstract of article by Popovich, Ye. A., amd Kuznetsova, O. M.]

[Text] It is shown that a directed selection of the number and magnitude of pulsing and stationary fields can be used to completely eliminate speed fluctuations in single-phase step motors in the two most characteristic modes of operation for these motors: in synchronous rotation when fed a sinusoidal current and when operated as a contactless DC motor supplied with square-wave pulsed current.

UDC 621.313.3

A METHOD OF DETERMINING THE ZERO-POSITION DEFLECTION OF ROTATING TRANSFORMERS WHEN THE TEMPERATURE OF THE ENVIRONMENT VARIES

[Abstract of article by Shnayderman, L. M., and Vlasova, T. M.]

[Text] An indirect method is suggested for determining the zero-position deflection of rotating transformers which is associated with the determination of e.m.f. fluctuations in a square winding.

UDC 621.313.045.57.072.9;621.314.57/001.5

REACTIVE FACTOR OF EDDY CURRENTS IN THE ROTOR CORE OF SYNCHRONOUS ALTERNATING-CURRENT MACHINERY

[Abstract of article by Shapiro, L. Ya., and Isembergenov, N. T.]

[Text] An expression is derived for the reactive factor of eddy currents in the rotor core of synchronous alternating-current machinery when the core is constructed from sheets of relatively great thickness. Curves are presented which show the dependence of the eddy-current reactive factor upon the ratio of the plates' thickness to the depth of electromagnetic-wave penetration.

UDC 621.313.2.004

EFFECT OF LIQUID-INSULATOR VISCOSITY UPON THE EFFICIENCY AND OPTIMUM PARAMETERS OF DIRECT-CURRENT MOTORS

[Abstract of article by Tokarev, B. F., Kholod, Yu. D., and Sadykov, S. P.]

[Text] Results are presented from "BESM" electronic computer calculations for an optimum-efficiency submersible DC motor based on the effect of the viscosity of the liquid insulator. The calculated data can be used to select a liquid dielectric for submersible motors.

UDC 621.313

SELECTION OF THE OPTIMUM NUMBER OF TURNS FOR EXCITER WINDINGS OF MOTORS WITH SHIELDED POLES

[Abstract of article by Sentyurikhin, N. I.]

[Text] This article examines the problem of specific optimization of the length and winding data for motors with shielded poles. When a series of motors is designed, it often becomes necessary to utilize this or that transverse configuration for motors of various outputs. This dictates the necessity of optimizing the winding data for the given configuration of stator plates. The maximum possible efficiency of the motor when restrictions have been placed upon the ratios of the starting and maximum torques and the magnitude of the net output is used as the criterion for the optimizing operation.

UDC 621-83.001.4

ON SELECTING A CRITERION FOR OPTIMIZING MOTORS IN ELECTRIC DIRECT DRIVES

[Abstract of article by Tsatsenkin, V. K.]

[Text] In the majority of cases in practice, an electric motor must provide a given rate of acceleration to a mechanism. It is shown that in a direct drive there exists a simple connection between the optimum diameter of the rotor in an electric motor and the given acceleration and machine constants. This article examines conditions for the physical realization of a motor with optimum dimensions or the utilization of other optimization criteria--for example, a minimum of losses in the copper of the armature.

UDC 621-083.001

A SEALED STEP ELECTRIC DRIVE WITH SEGMENTED STEP FOR MANIPULATORS

[Abstract of article by Rozhanskiy, Yu. Z.]

[Text] It is shown that the application of a step electric drive for sealed step-type metalworking equipment has a number of adavantages in comparison with the application of a DC drive and makes it possible to increase the drive's nominal torque.

UDC 621.316.8

DIALOG METHOD OF OPTIMIZATION--AN EFFECTIVE MEANS OF SOLVING THE PROBLEM OF DESIGNING ELECTROMECHANICAL DEVICES AND EQUIPMENT

[Abstract of article by Vysotkiy, A. F., Kolmakova, L. A., and Zaytsev, Yu. V.]

[Text] This article examines and analyzes questions regarding the use of the dialog method of optimization in order to solve the problem of designing electromechanical devices and equipment.

The article cites the characteristics of the dialog method of solving the problem of design and shows its advantages over the usual methods of calculation and design which are used at present by designers of instruments and devices.

Likewise analyzed are features of the dialog method of solving design problems--features which make it possible to effectively design electromechanical instruments and devices.

UDC 621.316.8

SEMICONDUCTOR THERMORESISTORS FOR START-CONTROL DEVICES OF ELECTRIC DRIVES

[Abstract of article by Zaytsev, Yu. V., Zharnovskiy, V. A., Kron, F. S., and Kolmakova, L. A.]

[Text] This article examines questions regarding the use of semiconductor power thermoresistors based on oxides and monocrystals of semiconducting materials for start-control devices of electric drives and cites the characteristics of semiconductor power thermoresistors. Examples are given of the application of semiconductor thermoresistors for electric-motor start-control devices.

UDC 621.318

CALCULATION OF THE PERMEANCE OF THE RUNNING CLEARANCE IN A SYMMETRICAL SEALED REED RELAY

[Abstract of article by Shoffa, V. N, and Davydov, S. V.]

[Text] This article demonstrates the feasibility of determining the permeance of the running clearance in a symmetrical sealed reed relay by means of measuring the maximum magnetic flux in the contact cores and the e.m.f. between them. An empirical formula is derived for calculating the permance of the running clearance. The results of the calculations are compared with data obtained using known formulas.

UDC 621.313.323

INVERTED HERMETICALLY SEALED DC MOTORS

[Abstract of article by Gertsov, S. M., and Knyazev, V. N.]

[Text] A description is presented of a new type of DC motor which has a fixed armature winding with a collector and a rotating inductor and brush assembly.

The hermetic sealing from the output side of the shaft is accomplished by introducing a nonmagnetic screen into the bore of the stator. The rotation from the rotor (inductor) of the electric motor is transmitted to the brush assembly through the screen by means of a magnetic clutch.

A description is presented of the possible design alternatives; operational and dynamic characteristics are given (under transient conditions); a comparison is made with the traditional types of DC motors.

UDC 621.318.5(088.8)

CALCULATION OF THE MAGNETOMOTIVE FORCE NEEDED TO TRIGGER A DIAPHRAGM-TYPE RELAY

[Abstract of article by Pushkov, A. S., and Novikov, A. G.]

[Text] This article examines a method for calculating the magnetomotive force needed to trigger a diaphragm-type relay using an equivalent magnetic circuit derived from an analysis of magnetic flux distribution under experimental conditions. Specific design features are indicated and analytical expressions are cited for the calculation of the permeance. The calculated error does not exceed 14 percent.

UDC 621.313

PREDICTING SPARKLESS COMMUTATION FOR DC MOTORS AT THE DESIGN STAGE

[Abstract of article by Volkov, V. S.]

[Text] This article examines the influence of armature-winding parameters on the range of the sparkless-operation zone. The range of the sparkless-operation zone is inversely proportional to the magnitude of the reactive e.m.f. A method of systematized experiment is employed to establish the influence of each of the parameters and their fluctuations upon the magnitude of the BDP [expansion not provided].

UDC 621.313.323-184.4:621.313.8

A MATHEMATICAL MODEL OF A SYNCHRONOUS RELUCTANCE MICROMOTOR FOR STUDYING VARIATIONS IN ROTATION

[Abstract of article by Kuznetsov, V. V.]

[Text] This article presents a method of quantitative analysis of the rotational instability of synchronous reluctance micromotors based on the serration of the core and the discreteness of the windings. The method is based upon a system of differential equations composed by the method of conductance of toothed contours.

UDC 621.313

FEASIBLE METHODS FOR REDUCING TEMPERATURE ERRORS IN ROTATING TRANSFORMERS

[Abstract of article by Shnayderman, L. M., and Vlasova, T. M.]

[Text] This article examines the reasons for the appearance of temperature errors in rotating transformers. Design and experimental methods are presented for reducing these errors.

UDC 621.-52.001.2

A UNIVERSAL POWER AMPLIFIER FOR A DISCRETE ELECTRIC DRIVE

[Abstract of article by Balkovoy, A. P., Piskunov, A. G., and Mayorov, V. V.]

[Text] This article examines a sampled-data current-control schematic of a power amplifier for a discrete electric drive. The conclusion is reached that the given circuit insures high power indicators thanks to the feasibility of regenerating the kinetic-energy of the drive's moving mass and the electromagnetic energy of the motor's windings.

UDC 621.313.323

METHODS OF DESIGNING ELECTRIC STEP MOTORS

[Abstract of article by Novakovskaya, Z. D., Popovich, Ye. A., Kuznetsov, V. V., and Pimakina, M. V.]

[Text] Methods are examined for designing electric step motors using physical models, active experiment and calculations on digital computers.



9512
CSO: 1860/24

ANNOTATION AND ABSTRACTS FROM COLLECTION 'PHYSICS OF SEMICONDUCTOR MATERIALS AND DEVICES'

Moscow TRUDY MOSKOVSKOGO ORDENA LENINA I ORDENA OKTYABR'SKOY REVOLYUTSII ENERGETICHESKOGO INSTITUTA, TEMATICHESKIY SBORNIK: FIZIKA POLUPROVODNIKOVYKH MATERIALOV I PRIBOROV in Russian No 512, 1981 (signed to press 9 Feb 81) pp 2, 75-80

[Text] This collection includes articles devoted to the investigation of the electrophysical, optical, galvanomagnetic and acoustoelectronic properties of a broad class of I-VI, II-VI and III-V semiconductor compounds and solid solutions, as well as silicon and oxides of zirconium, vanadium, yttrium and scandium. A number of studies examine the physical processes taking place in monocrystalline p-type semiconductor structures, photovoltaic cells and illumination-power meters.

This collection will be useful to a wide circle of readers--scientific workers and engineers working in the areas of deriving, investigating and applying various semiconductor materials as well as for undergraduate and graduate students in the upper classes of the corresponding specialities.

UDC 621.383.44:546.28.001.5

EFFICIENCY OF CONVERSION OF MONOCHROMATIC RADIATION BY CONVENTIONAL AND PLANAR PHOTOVOLTAIC CELLS

[Abstract of article by Vasil'yev, A. M., Yermakov, B. V., and Kozintsova, M. B.]

[Text] This study compares the efficiency of conventional and planar photovoltaic cells. Results are cited for calculations of optional values of efficiency and irradiance for the two types with various values of the relative base thickness.

UDC 535.231.6:537.324

TEMPERATURE DEPENDENCE OF THE SENSITIVITY OF SILICON-BASED DEVICES FOR MEASURING THE POWER OF OPTICAL RADIATION

[Abstract of article by Aleksandrov, Yu. V., and Sharikin, V. F.]

[Text] This article examines the temperature dependence of the sensitivity of ideal devices for measuring the power of optical radiation using silicon thermopiles. It is demonstrated that the nature of the temperature dependence of the sensitivity is determined by the meter's design. The value for the temperature variation in the thermal conductivity of silicon is pointed out.

UDC 539.124.143:546.47

PHOTOSENSITIVE ELECTRON PARAMAGNETIC RESONANCE OF $Cr^+$ IONS IN ZINC SELENIDE

[Abstract of article by Gorn, I. A., and Chernyy, V. D.]

[Text] This article experimentally examines the spectrum of optical excitation of photosensitive electron paramagnetic resonance of $Cr^+$ ions in a monocrystal of zinc selenide. A power model is suggested for the level of $Cr^{2+}$ and $Cr^+$ ions in zinc selenide.

UDC 539.211:548.552.22

CALCULATION OF THE ELECTROPHYSICAL CHARACTERISTICS OF FINE PARTICLES IN INSULAR FILMS

[Abstract of article by Podlubin, L. I., Avilova, I. V., and Chuchukina, L. Ya.]

[Text] The density-functional method is employed for fine metallic particles with a considerable surface curve. A calculation is made of the profile of electron density, the electric potential distribution, the surface energy and the operation of the output. The contributions of the kinetic, exchange, correlation, nonuniform and Coulomb's components are taken into account. It is shown that none of the interacting mechanisms can be ignored.

UDC 537.311.33

DETERMINING THE OPTIMUM ALLOY LEVEL OF SILICON ARMS FOR THERMOELECTRIC DEVICES USED TO MEASURE THE POWER OF OPTICAL RADIATION

[Abstract of article by Barto, M. P., and Mochalova, L. Yu.]

[Text] This article examines the temperature dependence of the differential thermal e.m.f. of silicon with various alloy levels, and, on the basis of the results obtained, provides recommendations regarding the suitability of utilization of low-resistance silicon whose differential thermal e.m.f. is in the region of superheating determined by the instrument's dynamic range and, for all practical purposes, is not temperature dependent.

UDC 541.133

EFFECT OF SMALL ADDITIONS OF ALLOYS ON THE ELECTRICAL CONDUCTIVITY OF A MONOCRYSTAL $0.9ZrO_2-0.IY_2O3$

[Abstract of article by Gruzdev, A. I., and Ryazantsev, A. D.]

[Text] Within a broad range of temperatures, measurements are made of the mutual and electron conduction of monocrystals of solid solutions of $0.9\ ZrO_2-0.09\ Y_2O_3-$

0.01 $Ln_2O_3$ and 0.9 $ZrO_2$-0.097 $Y_2O_3$-0.003 $Me_xO_y$, where Ln is the rare earth element and Me is an element of the iron group. A reduction is detected in the activation energy of the mutual and electron conductance with an increase in the atomic number of the rare-earth element.

UDC 534.29.001.5

MANIFESTATION OF THE QUANTUM DIMENSIONAL EFFECT IN ACOUSTOELECTONIC INTERACTION

[Abstract of article by Gavrilin, V. I., Gulyayev, A. M., and Bashkirov, A. M.]

[Text] This article examines the effect of the thickness of a semiconductor film on the interaction of an electrical field of a surface acoustic wave with free carriers in the film. It is pointed out that the effect of dimensional quantization leads to oscillations of the acoustoelectrical current in a structure with a film of variable thickness.

UDC 535.37:546.47

FLUCTUATIONS IN COMPOSITION AND THE NATURE OF NONUNIFORMITIES IN LOW-RESISTANCE MONOCRYSTALS OF ZINC SULFIDE ALLOYED WITH ALUMINUM

[Abstract of article by Morozova, N. K., Galstyan, V. G., Muratova, V. I. and Filipova, V. A.]

[Text] Using the spectra of microcathode luminescence, a study was conducted of the nonuniform distribution of aluminum and oxygen in monocrystals of sphalerite grown from a melt.

UDC 621.315.543:621.315.592

THE APPLICATION OF ELECTROACOUSTIC METHODS FOR STUDYING INTERNAL ELECTRICAL FIELDS IN DISORDERED MATERIALS

[Abstract of article by Borovov, G. I., and Voronkov, E. N.]

[Text] It is shown that acoustic oscillations appear in a number of vitreous chalcogenide semiconductors under the application of an alternating electrical field. Cooling to 150 to 110°K brings the material to a ferroelectric state. In silicon-based monocrystal p-type semiconductor structures, the amplitude of the acoustic signal depends upon the magnitude and the sign of the fixed bias. This article points out the feasibility of studying the processes of captured-charge relaxation.

UDC 546.47.21.535

EFFECT OF HEAT TREATMENT ON THE RESIDUAL CONDUCTIVITY OF ZINC OXIDE MONOCRYSTALS GROWN BY THE HYDROTHERMAL SYNTHESIS METHOD

[Abstract of article by Malov, M. M., and Mendakov, M. N.]

[Text] This article examines the kinetics of attenuation, the quasi-static volt-ampere characteristics and the temperature dependence of the residual conductivity factor of samples cut along the (000I), (000I), (I0I0) and (I0II) faces of hydrothermal monocrystals of zinc oxide, depending upon the conditions under which they were grown and heat-treated. The best examples for an optical memory system prove to be those crystals which are cut along the (000I) and (I0I0) crystal faces and which undergo treatment in air in a suspension of lithium carbonate.

UDC 537.311.33:621.382.323

ELECTRON MOBILITY IN THIN LAYERS OF SILICON ON SAPPHIRE

[Abstract of article by Smotrakov, A. A., Soldatov, V. S., Varlashov, I. B., and Kalinin, A. V.]

[Text] This article employs the field-effect and Hall-effect methods to examine silicon-on-sapphire p-type films with a silicon layer 0.6 μm thick. It is established that the concentration and mobility of electrons decreases along a line away from the junction with the silicon oxide. A calculation is made of the mobility profile in a proposal which suggests that the major dispersion mechanisms are dispersion on charged dislocations and on the surface. Good correlations are obtained between the calculated and experimental data.

UDC 621.315.592

INVESTIGATION OF THE ELECTROABSORPTION AND ELECTROREFLECTION SPECTRA OF ZINC SELENIDE MONOCRYSTALS

[Abstract of article by Khirin, V. N., and Virchenko, S. Ye.]

[Text] This article examines the electroreflection and electroabsorption spectra of ZnSe monocrystals at 77.3°K depending upon the magnitude of the modulating voltage at a frequency of 365 Hz. A bound-exciton band is detected on the neutral acceptor in the electroreflection spectrum, while impurity-absorption bands are found in the electroabsorption spectrum.

UDC 539.216:546.42.28:543

INFRARED TRANSMISSION SPECTRUM OF YScO

[Abstract of article by Klimova, S. M., Uskova, Z. A., and Polyakova, I. K.]

[Text] The transmission spectra of oxides of yttrium, scandium and yttrium scandiate are examined. The infrared band of the yttrium scandiate tramsmission spectrum is identified.

UDC 546.681.171.1.546.681.682

OPTICAL AND ELECTRICAL PROPERTIES OF EPITAXIAL LAYERS OF GALLIUM NITRIDE IRRADIATED BY ELECTRONS WITH ENERGIES OF $0.1\text{-}1._0$ MeV

[Abstract of article by Karentnikov, I. A., Mironenko, L. S., Buronov, A. G., and Kuznetsov, A. V.]

[Text] Through the use of optical and electrical measurements, a determination is made of the "threshold" energy of formation of donor-type radiation defects in gallium nitride. Results are presented of a theoretical calculation of the possible concentration of defects in sublattices of gallium and nitrogen which appear as a result of radiation. A proposal is made regarding the presence of impurity defects in the layers in considerable quantity due to hydrogen.

UDC 621.315.592

USE OF THE REACTIVE SPUTTERING METHOD TO OBTAIN VANADIUM DIOXIDE FILMS ON METALLIC SUBSTRATES

[Abstract of article by Mokrousov, V. V., Kornetov, V. N., Dmitriyev, V. A., Borodin, A. S., Khanin, V. A., and Belyakov, V. I.]

[Text] This article examines the properties of vanadium dioxide films on metallic substrates of Al, Cr, V, Ni, Re and Pt. It is shown that the greatest light contrast between phases with a phase shift of Al-substrate reflectors is achieved with an oxide layer 1650 Å thick. Examination of the other substances requires further development of methods for deposition of oxide layers as well as measures directed at improving the adhesion of $VO_2$ to metallic substrates.

UDC 548.55:535

OPTICAL PROPERTIES OF CuCl POWDERS OBTAINED BY VARIOUS METHODS

[Abstract of article by Boroshneva, T. V.]

[Text] An investigation is made of the diffuse-reflection and cathode-luminescence spectra in the low-temperature range for analytically pure CuCl powders and for powders obtained by pulverizing monocrystals. The spectral position, intensity and half-thickness of the reflection and cathode-luminescence bands are analyzed.

UDC 548:55

GROWTH AND OPTICAL PROPERTIES OF CuCl MONOCRYSTALS

[Abstract of article by Shalimova, K. V., Boroshneva, T. V., and Dobrshchanskiy, G. F.]

[Text] Monocrystals of CuCl are grown using the Bridgeman method with the introduction of various fluxes into the initial mixture. Reflection spectra are obtained as well as photoluminescence and excitation spectra for the monocrystals grown. Analysis and identification of the spectral bands is carried out.

UDC 546.47 21.535.374

LUMINESCENCE OF BOUND EXCITONS IN ZINC OXIDE

[Abstract of article by Kutepova, V. P., and Malov, M. M.]

[Text] This article identifies for the first time the ultraviolet luminescence bands of zinc oxide caused by the radiation annihilation of excitons localized on singly and doubly ionized interstitial atoms of zinc oxide, lithium and sodium and on ions of lithium and sodium which create acceptor defects when replaced with zinc.

UDC 546.47.21.535

OPTICAL PROPERTIES OF ZINC ORTHOTITANATE POWDERS

[Abstract of article by Agafontsev, V. F.]

[Text] This article examines the low-temperature spectra of luminescence, excitation and reflection for zinc orthotitanate powders obtained by the oxolate method and subjected to chemical treatment to remove free zinc oxide. An identification of the spectrum obtained is made.



9512
CSO: 1860/21

UDC [621.59:621.37.39]:629.12

CRYOGENIC ELECTRONICS IN MARINE RADIO EQUIPMENT

Leningrad KRIOGENNAYA ELEKTRONIKA V MORSKOM RADIOOBORUDOVANII in Russian 1980 (signed to press 8 Jul 80) pp 2-3, 222-223

[Annotation, foreword and table of contents from book "Cryogenic Electronics in Marine Radio Equipment", by Yevgeniy Germanovich Pashchenko, Anatoliy Mikhaylovich Pozharov and Viktor Vasil'yevich Tikhonov, Izdatel'stvo "Sudostroyeniye", 753 copies, 224 pages]

[Text] An analysis is provided of the effectiveness of using cooled and superconducting electronic units in marine radio equipment. New types of devices based on the phenomenon of superconductivity are studied. Their physical nature, operating principle and possibilities of production are reviewed. The book contains a survey of domestic and foreign works published at various times in the periodical literature, as well as results of the authors' research.

It is intended for engineering and technical personnel, marine radio equipment designers, VUZ students, and a wide range of specialists working on developing low-noise radio equipment.

Illustrations: 118. Tables: 12. Bibliography: 133 titles.

## Foreword

Developers and designers of radio equipment for maritime uses are currently devoting increasing attention to cryogenic electronics as a means of raising the quality of marine radio equipment. For example, by using extensive cooling it is theoretically possible to lower the dimensions of certain types of antennas, raise the frequency selectivity and total noise of immunity of radio electronic equipment while raising its sensitivity, increase the directional properties of electrically small aerials, etc. However, the conditions under which cryogenic radio electronic equipment is used at sea are very specific, which determines both the maximum allowable characteristics of cryogenic radio electronic equipment and its effectiveness, and the advisability of using intense cooling under sea conditions.

This book examines the possibilities of raising the basic electrical parameters of radio electronic equipment in the use of cryogenic temperatures, with consideration of certain specific features characteristic of such equipment's use at sea.

The first chapter briefly explains the basics of cryogenic radio electronics.

The second and third chapters are devoted to the theory and technology of scanner assemblies. The limit characteristics of superconducting antennas, the effect of the deck, superstructure and sea water on them, and their design features are examined. The question is investigated of the possibility of reducing the size and increasing the sensitivity and spatial selectivity of scanners.

The fourth chaper examines cooled matching devices and preselectors.

The fifth and sixth chapters are devoted to amplifying and heterodyne devices, built both on transistors and on specific components based on superconductivity physics effects.

The last chapter is devoted to technological and operational features of cryo-electronic sea radio equipment, including cryogenic provision of cooled units of radio electronic equipment of marine facilities.

All the chapters were written jointly by the authors. V. V. Oshiyko and E. T. Krylov participated in writing sections 4.2 and 4.3.; section 3.3 was written by O. G. Vendik.

Certain questions discussed in the book might be controversial. The authors will be grateful for comments and suggestions on the book's contents.

The authors wish to express their gratitude to Professor V. I. Vinokurov and Candidate of Technical Sciences A. N. Petrov, whose comments and suggestions helped to improve the book.

Table of Contents

9875
CSO: 1860/4

UDC: 681.586.72

DESIGN AND PRODUCTION TECHNOLOGY FOR MICROELECTRONIC DIGITAL MEASURING INSTRUMENTS

Moscow KONSTRUIROVANIYE I TEKHNOLOGIYA PROIZVODSTVA MIKROELEKTRONNYKH TSIFROVYKH IZMERITEL'NYKH PRIBOROV in Russian 1981 (signed to press 3 Apr 81) pp 2-4, 174-175

[Annotation, foreword and table of contents from book "Design and Production Technology for Microelectronic Digital Measuring Instruments", by Yuriy Sergeyevich Mal'tsev, Energoizdat, 15,000 copies, 176 pages]

## Annotation

[Text] The circuit engineering, design methods and production technology of microelectronic digital measuring instruments based on integrated microcircuits (IC) are examined. The problem touched upon include using design and technological methods to ensure noise tolerance, reliability and stability of instruments, matching of ICs with indicators and other external devices, effective cooling, etc. Features of installing, assembling, adjusting and powering microelectronic digital instruments are described. Descriptions are given for the circuits and construction of the best domestic and foreign models.

The book is intended for engineering-technical design bureau workers and technologists involved in the construction and production of instruments.

## Foreword

The development of microelectronics involves the requirement for improving electronic equipment, increasing its reliability, reducing its cost, increasing its speed and reducing power consumption.

The microminiaturization of measurement devices, particularly digital measuring instruments, has brought about a qualitative change in the characteristics of measurement facilities. The use of the principles of microelectronics in the creation of measurement modules in digital instruments has made it possible to improve measurement accuracy through the fabrication of a number of elements within a single technological cycle. It has become possible to create measurement facilities which are new in principle and whose implementation without integrated circuits would be senseless because of the increased number of elements and complication of instrument circuitry. Instruments have been created which combine the functions of measurement facilities and devices which process measurement results. This has made it possible to process the results of a series of measurements simultaneously with the taking of those measurements, to linearize the characteristics of nonlinear sensors, to introduce scaling factors needed to reflect information on natural scales, to calculate the results of indirect measurements, etc.

The design principles of digital measuring instruments have also changed significantly. The appearance in large-scale production of a number of special microcircuits which replace entire functional blocks in measurement instruments (analog-digital and digital-analog converters, logic units, etc.) has contributed to accelerating the design of new instruments. It has become possible for the developer to concentrate his efforts on solving such problems as proper arrangement of microcircuits, optimal lay-out of printed circuits, prevention of parasitic coupling and induction, ensuring effective heat removal from instrument housings, etc.

The easy availability of inexpensive microelectronic operational amplifiers with guaranteed characteristics has made it possible to change the principles of designing the circuits of measurement modules in instruments, which have begun to be based primarily on the multifunctional utilization of operational amplifiers, which has led to standardization of circuit treatments. Significant shifts have also occurred in the area of digital instrument production techology. Practically all instruments are now built using printed circuitry, which has resulted in a thorough change in the technological processes of wiring and assembling them. The sharp reduction in the size and weight of instruments has made it possible to fabricate their housings using efficient technological processes (using formed plastic, etc.).

The change in the design and production technology of instruments has brought about a change in the nature of the production and an increase in the amount of electrical wiring and assembly operations at the cost of reducing the proportion of preparatory and other ancillary operations. The amount and complexity of adjustment and checking operations has increased because of the more complicated functioning algorithms used in the instruments. This has resulted in the introduction of automated computer-based testing and technological devices.

The book attempts to generalize the scattered material published here and abroad which reflects the main problems of the design and production technology of microelectronic digital instruments. The author is deeply grateful to book reviewer I. Ya. Kaverkin and editor I. D. Belikov for their helpful advice and remarks, which helped to improve the book. Understanding clearly that the book is not without shortcomings, the author will be pleased to receive critical comments, which should be sent to 113114, Moscow, Shlyuzovaya Naberezhnaya, 10, Energoizdat.

Table of Contents

6900
CSO: 1860/11

UDC 621.394

DIGITAL INFORMATION TRANSMISSION VIA LOW-SPEED COMMUNICATION CHANNELS

Moscow PEREDACHA DISKRETNOY INFORMATSII PO NIZKOSKOROSTNYM KANALAM SVYAZI in Russian 1980 (signed to press 23 Jul 80) pp 2-3, 126-127

[Annotation, foreword and table of contents from book "Transmission of Digital Information Via Low-Speed Communication Channels", by Madzhidulla Nigmatovich Aripov, Izdatel'stvo "Svyaz'", 6700 copies, 128 pages]

[Text] Questions are discussed of noise-proof transmission of digital information via low-speed communication channels. Existing methods of evaluating such channels' quality and questions of distortion of unit elements and their grouping into packets are examined; the effectiveness of methods of raising channel quality is evaluated.

For engineering and technical personnel in the field of digital information transmission.

## Foreword

Our country is currently setting up the Nationwide Automatic Information Collection and Processing System (OGAS), required for keeping records on, planning and managing the national economy based on a state network of computer centers and the country's Unified Automatic Communications Network (YeASS). The 25th CPSU Congress laid down the tasks of organizing the Nationwide Data Transmission System (OGSPD). The first stage in creating the YeASS is being accomplished based on low-speed communication channels (50-200 baud), meeting the requirements of 60-80% of the automatic systems of control of technological processes formed using TT-48, TT-12 and other systems.

Information theory specialists in recent years have turned away from idealized models of channels, and are studying models approximating actual channels. A correct solution to the problem of reducing errors during digital information transmission depends on studying error statistics and constructing a mathematical model of the errors' source. The evolution of data transmission systems shows that a tendency can be noted towards complication of error protection devices, which makes it necessary to accumulate larger amounts of error statistics since the effectiveness of using one or another error protection method basically depends on the number of increasingly infrequent errors, not detected by the given method. In connection with this, special error flow analyzers have been developed, algorithms for computer processing of these data are being created, and error flow imitation devices are being designed.

Solving the problem of optimizing data transmission systems only on the basis of an error source model results in an increase in code redundancy, with a corresponding rise in transmission speed loss, while the coding and decoding devices gain in complexity as the unit length grows. Selection of the coding method must therefore be done not only on the basis of error statistics, but also with allowance for possibilities of using signal quality detectors which enable simplification of the coder and decoder and reduction of their cost.

This book is devoted to questions of generalization and further development of research on methods to analyze and monitor various parameters of code signal distortion in actual low-speed communication channels, and to the search for effective techniques for raising reception fidelity by parametric methods.

The author expresses his sincere gratitude to Professor V. O. Shvartsman, and to the reviewer, Candidate of Technical Sciences L. I. Zubovskiy, for their helpful discussions of the book.

Comments regarding the book should be sent to the "Svyaz'", Publishing House, 101000, Moscow, Chistoprudniy Blvd., Bldg. 2.

Table of Contents

9875
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UDC 621.3.01(03)

ELECTRICAL ENGINEERING HANDBOOK

Moscow ELEKTROTEKHNICHESKIY SPRAVOCHNIK (V TREKH TOMAKH), TOM 2: ELEKTROTEKHNICHESKIYE USTROYSTVA in Russian 1981 (signed to press 3 Mar 81) pp 2-3, excerpts pp 5, 59, 103, 148-149, 243, 266, 298, 373, 418-419, 483, 560, 615

[Annotation, table of contents, note from the editoral board, and sectional contents from book "Electrical Engineering Handbook (in 3 volumes), Volume 2: Electrical Devices", 6th edition, revised and enlarged, edited by professors of the Moscow Power Engineering Institute V. G. Gerasimov, P. G. Grudinskiy, L. A. Zhukov, V. A. Labuntsov, I. N. Orlov (editor in chief), M. M. Sokolov, A. M. Fedoseyev, A. Ya. Shikhin, and engineer I. V. Antik, Energoizdat, 80,000 copies, 640 pages]

[Text] This book contains information on resistors, capacitors, reactors, transformers and autotransformers, electric machines (including machines for automatic devices), high and low voltage electric devices, high-voltage equipment sets, valve converters of electric energy, and chemical sources of current. The previous, 5th, edition of this handbook was published in 1975.

The book is intended for electrical engineers.

Contents



Note from the Editorial Board

Materials of the second volume were prepared by:

Section 16 -- Candidate of Technical Sciences Ye. G. Akimov (16-1 and 16-2); Candidate of Technical Sciences, Docent M. A. Zhavoronkov; and Candidate of Technical Sciences, Docent A. A. Chunikhin (16-3).

Section 17 -- Doctor of Technical Sciences, Professor P. M. Tikhomirov.

Section 18-20 -- Doctor of Technical Sciences, Professor A. V. Ivanov-Smolenskiy; Doctor of Technical Sciences, Docent F. M. Yuferov (19-16, 19-17, 19-39, 19-40 and 20-15); Engineer M. A. Avanesov (19-10 -- 19-15, 19-33 -- 19-37 and 20-11 -- 20-13).

Section 21 -- Doctor of Technical Sciences, Docent F. M. Yuferov.

Sections 22 and 23 -- Candidate of Technical Sciences, Docent A. A. Chunikhin (22-1 -- 22-4, 22-6, 23-1 -- 23-8, 23-10 and 23-11); Candidate of Technical Sciences, Docent M. A. Zhavoronkov (22-5, 22-7 -- 22-9, 23-9 and 23-12).

Section 24 -- Doctor of Technical Sciences, Professor I. S. Tayev (24-1 -- 24-7); Candidate of Technical Sciences, Docent G. G. Nesterov (24-8 -- 24-10).

Section 25 -- Engineer G. Ya. Kazanovich (25-1 -- 25-5); Candidate of Technical Sciences, Docent V. S. Zhdanov (25-6).

Section 26 -- Candidate of Technical Sciences, Docent N. N. Bogdanov; Candidate of Technical Sciences, Docent O. G. Bulatov and Senior Lecturer M. L. Fratkina.

Section 27 -- Doctor of Chemical Sciences, Professor N. V. Korovin.

The materials of the sections of this volume were examined by department heads of the Moscow Power Engineering Institute: Doctor of Technical Sciences, Professor I. P. Kopylov; Doctor of Technical Sciences, Professor V. A. Labuntsov; Candidate of Technical Sciences, Professor B. N. Neklepayev; and Doctor of Technical Sciences, Professor I. S. Tayev.

The materials of this volume were edited by Professor V. A. Labuntsov and Professor A. Ya. Shikhin.

Section 16. Resistors, Capacitors, and Reactors

Contents

Section 17. Transformers and Autotransformers

Contents

Section 18. General Problems of Electric Machines

Contents Page

A. Basic Definitions and Specifications



B. General Theoretical Problems



Section 19. Alternating-Current Electric Machines

Contents Page

A. Asynchronous Machines

Section 20. Direct-Current Machines and Commutator Motors

Contents

Section 21. Electric Machines of Automatic Devices

Contents Page



Section 22. High Voltage Switching and Protective Equipment.

Contents Page

Section 23. Current and Voltage Transformers

Contents Page

Section 24. Low Voltage Devices

Contents Page

Section 25. High Voltage Equipment Sets.

Contents



Section 26. Valve Converters of Electric Energy

Contents

Contents

10233
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IMPURITIES AND POINT DEFECTS IN SEMICONDUCTORS

Moscow PRIMESI I TOCHECHNYYE DEFEKTY V POLUPROVODNIKAKH in Russian 1981
(signed to press 26 Mar 81) pp 2-5, 247-248

[Annotation, foreword (excerpts) and table of contents from book "Impurities and Point Defects in Semiconductors", by Vadim Valentinovich Yemtsev and Tat'yana Vadimovna Mashovets, Izdatel'stvo "Radio i svyaz'", 4,000 copies, 248 pages]

Annotation

[Excerpts] The findings from investigating impurities and point defects in diamond-like semiconductors are presented. Some sections of the book are written in condensed fashion, and new aspects of the problem of defect formation and migration are considered in more detail. The book is intended for scientific workers and engineers in corresponding specialties.

[The book was reviewed by Doctor of Technical Sciences Yu. A. Kontsevoy and Professor P. V. Pavlov.]

Foreword

It is well known that the most important properties of semiconductors, from the practical viewpoint, are determined by the nature and concentrations of crystal lattice defects, which may include impurity atoms.

The extensive use of semiconductor devices in nuclear and space technology is now stimulating intensive study of defects occurring in semiconductors under the influence of radiation. However, problems concerning the properties of impurities on the one hand, and radiation defects on the other, are generally discussed separately in the scientific literature. One feature of the present monograph is the fact that it examines impurities in close association with other crystal lattice point defects; in the real world this connection is dictated by their interaction.

The primary attention in the book is devoted to diamond-like semiconductors. The first section discusses the power spectra and microstructure of point defects, while the second is concerned with processes of generation, migration and interaction of various types of defects, and annealing processes. The properties of elongated defects and disordered regions are not discussed: these questions have been considered in detail, e.g., in G. Matare's monographs Elektronika defektov v poluprovodnika (The Electronics of Defects in Semiconductors) (Moscow, Mir Press, 1974), R. F. Konopleva, V. L. Litvinov and N. A. Ukhin's Osobennosti radiotsionnogo povrezhdeniya poluprovodnikov chastitsami vysokikh energiy (Singularities of Radiation Damage to Semiconductors by High-Energy Particles) (Moscow, Atomizdat Press, 1971) and R. F. Konopleva and V. N. Ostroumov's Vzaimodeystviye zaryazhennykh chastits vysokikh energiy s germaniyem i kremniem (Interaction of High-Energy Charged Particles With Germanium and Silicon) (Moscow, Atomizdat Press, 1975).

The book presents some of the results obtained in the Laboratory of Nonequilibrium Processes in Semiconductors of the USSR Academy of Sciences Physico-Technical Institute imeni A. F. Ioffe under the supervision of Professor S. M. Ryvkin, who is one of the initiators of research on radiation defects in semiconductors in this country.

It is the authors' pleasant duty to express their genuine thanks to Doctor of Physical and Mathematical Sciences M. I. Klinger and Candidate of Physico-Mathematical Sciences N. A. Vitovskiy for their frequent useful discussions on the problems touched upon in this monograph.

The authors are deeply indebted to N. M. Yemtseva, Yu. N. Daluda, and N. A. and A. V. Bagryanskiy, who rendered a great deal of assistance in preparing the manuscript.

Table of Contents

6900
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UDC 621.382

NEURISTOR AND OTHER FUNCTIONAL CIRCUITS WITH VOLUME COUPLING

Moscow NEYRISTORNYYE I DRUGIYE FUNKTSIONAL'NYYE SKHEMY S OB"YEMNOY SVYAZ'YU in Russian 1981 (signed to press 9 Apr 81) pp 2-4, 110-111

[Annotation, introduction and table of contents from book "Neuristor and Other Functional Circuits With Volume Coupling", by Vitaliy Ivanovich Stafeyev, Konstantin Fedorovich Komarovskikh and Grigoriy Ivanovich Fursin, Izdatel'stvo "Radio i svyaz'", 10,000 copies, 112 pages]

Annotation

[Text] This book examines the operating principle of the neuristor -- a multifunctional element which executes various logic operations and stores information. Various designs of neuristor and other functional circuits are described: those based on semiconducting devices with negative resistance, laser-active media, superconducting devices and tunnel diodes, and injection-fed integrated circuits. Technological, circuit engineering and applications features of these functional circuits are given.

The book is intended for a broad class of engineers working in the area of microelectronics and electronic technology. [Book reviewed by Doctor of Technical Sciences D. I. Yuditskiy and Candidate of Technical Sciences B. A. Kalabekov.]

Introduction

The extensive introduction of computer technology into all branches of the economy and the rapid development of integrated automation of production processes require the creation of inexpensive, economical computing devices. The search for new ways of creating such microelectronic devices in order to expand their functional capabilities and improve reliability sharply is extremely important.

The primary difficulties of modern microelectronics involve the problem of the "tyranny of numbers" of integrated-circuit components, which results in a reduction in the reliability and a reduction in the output of good circuits. The appearance of this problem is caused, on the one hand, by the sharp complication in the functions executed by electronic equipment, and on the other, by the traditional circuit engineering approach used in planning, where expanded functional capabilities of equipment is provided only by increasing the number of components, primarily transistors, rather than making fuller use of solid-body physical phenomena.

One of the methods of overcoming the "tyranny of numbers" is to use negative-resistance devices as active elements: because of the presence of positive internal feedback, these are very simple functional devices [1,2,12]. The S-devices which have been known for over 20 years [11,17,18,19] are now used extensively in widely varying equipment. In particular, high-efficiency light sources and photodetectors based on S-diodes were developed a few years ago, as were high-speed memory elements for static and dynamic LSI memories, shift registers and logic circuits based on plasma-coupled S-devices [2,11,12]. The storage density of these devices 1000 bits/$mm^2$ which exceeds the density of the $I^2L$-circuits based on p-n-p-n type multilayer structures operating in the injection state, which are undergoing intensive development, etc.

The creation and application of neuristors is of particular interest. As solid-state analogs of neural fibers, neuristors have a number of remarkable properties which make them highly reliable multifunctional elements which execute any logic operations as well as store information. The appearance of the first neuristors coincided with the birth of integrated transistor electronics, which delayed their extensive application in computing devices. However, major successes in technology and circuit engineering plus the use of LSI, as well as the newly awakened interest in neuristors on the part of radioelectronic equipment developers, allow us to hope that neuristors will soon provide the basis for the creation of efficient, reliable computing devices with associative and parallel information processing which will implement the many principles of neural networks and homogeneous media with adaptive and variable logic structure.

The present book generalizes the results of research on neuristors and certain other types of functional circuits which has been undertaken in the USSR and abroad over the past 15 years. A great deal of information on different neuristor designs, the physics of their operation and fundamental circuit engineering principles are systematized; various types of negative-resistance devices used to implement neuristors and other volume-coupled circuits are described. Features of constructing functional circuits using S-devices are examined, and the latter are compared with IC using IGFETS and TTL- and $I^2L$- ICs. A considerable portion of the material presented is based on original research done by the authors.

Table of Contents

6900
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NON-DESTRUCTIVE TEST METHODS TO DETECT FAULTY RADIO EQUIPMENT

Kiev NERAZRUSHAYUSHCHIYE METODY OBESPECHENIYA NADEZHNOSTI RADIOELEKTRONNOY APPARATURY in Russian 1980 (signed to press 3 Mar 80) pp 4-8, 198-199

[Annotation, introduction and table of contents from book "Non-destructive Methods for Guaranteeing Reliability of Radio-Electronic Equipment", by Mikhail Makarovich Nekrasov, doctor of technical sciences, Vitaliy Vasil'yevich Platonov and Lyudmila Ivanovna Dadeko, candidates of technical sciences, Izdatel'stvo "Tekhnika", 3700 copies, 200 pages]

[Text] In the book, methods for detection and elimination of potentially unreliable items are set out. Data from new methods for detecting hidden flaws in components at the designing and operations stages are presented. Modern equipment for operational inspection of radio-electronic equipment under production conditions is described.

The book is intended for engineering and technical workers studying the operation and development of radio-electronic equipment, and it may also be useful to students at VUZs for the appropriate specialties.

INTRODUCTION

Reliability is the property of an object to perform its prescribed functions, preserving in time the value of established operating indicators within given limits which correspond to given modes and conditions for the employment of maintenance, repair, storage and transportation.

The reliability of electronic items is determined by external influencing factors or modes of operation or internal influencing factors, among which are aging, wear and processes leading to flaws and nonhomogenieties in component structure. Indicators of the object's reliability are a function of the parameters of the elements and the rate of change of these parameters, given exposure to various factors. Among the basic external influencing factors are mechanical, temperature, climatic, electrical radiation and other stresses. A breakdown in the functioning of an object in the process of its operation is conditioned by a change in the object's structure and it results in its failure. The structure of an object is formed during design in accordance with its manufacturing technology. However, deviations from the optimal structure of the object in the course of its creation which are conditioned by flaws in the original materials and by undetectable and uncontrollable fluctuations of the manufacturing process are unavoidable. If identical objects were to be obtained at the end of the production cycle, questions of reliability would be solved. In actuality, for any lot, objects which are manufactured from the same materials according to the same technology and on the same equipment are not identical. Even if the differences in the objects are functionally insignificant, they could result in the fact that indicators of individual reliability of the objects will be distinguished within rather broad boundaries.

The problem of nondestructive monitoring of object reliability is in essence the sorting of objects according to the traits of a standard. It is sufficient to divide the group of elements being tested into two groups: more reliable and less reliable. Sorting is done using measurements of informative parameters (those which characterize the ability to perform the basic function), the detection of which is frequently complex for a specific type of object since a study of the object's breakdown processes during operation is required. The informative parameters are usually selected from their possibility to depict load distribution within the object.

An important moment in the development of questions of reliability is the relationship to the phenomenon of failure. If one assumes that failure is a random event unassociated with the structure of an object, then probability and statistical methods are used in order to determine the parameters which characterize it. Here it is necessary to consider that requirements imposed on reliability of modern components are so high that the process itself of obtaining information about their reliability indicators poses significant difficulties. For example, the application of statistical methods to determine the reliability of components which are characterized by a failure of $10^{-7}$ per part [ch$^{-1}$], given a sampling of $10^3$ items will require testing, the duration of which will be about 10 years. Moreover, a qualitative determination of the reliability indicators does not yet resolve questions of increasing the reliability for the objects being studied. Labor intensiveness, the low level of information content in regard to increasing the objects, the impossibility of operative control of the manufacturing process with this goal in mind and the high cost of statistical tests in order to determine the reliability of objects all result in the need for development of operative nondestructive methods for predicting reliability. In particular, an attempt is made in this work to generalize materials on the basis of nondestructive inspection for reliability of certain radio-electronic components based on the use of their informative parameters. If one is to consider that failures are caused by processes of breakdown of the objects and are determined by magnitudes of influencing factors in the weakest link in the structure of the object, then predicting failures requires the detection of physical-chemical processes of aging which cause it. In practice, a dialectical unity of probability-and-statistical and physical tendencies (an overall approach) takes place. Such an approach is in complete accord with the principle of complementarity [13, 24].

Frequently physical methods are constructed on the principle of measuring parameters of non-unifirmity, i.e. areas in the working body of the object where the stress is greater than rated stress. Determining the actual magnitude of stress in the weakest link of the working body of the object with the aid of informative parameters permits us to improve the reliability of the probability-and-statistical appraisals and the accuracy of the predictions.

CONTENTS

9194
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NONLINEAR HYDROACOUSTICS

Leningrad NELINEYNAYA GIDROAKUSTIKA in Russian 1981 (signed to press 27 Mar 81) pp 2-4, 262-264

[Annotation, foreword and table of contents from book "Nonlinear Hydroacoustics", by Boris Konstantinovich Novikov, Oleg Vladimirovich Rudenko and Vladimir Ivanovich Timoshenko; Editorial board: A. P. Yevtyutov, A. Ye. Kolesnikov, Ye. A. Korepin, V. V. Ol'shevskiy, L. V. Orlov, A. L. Prostakov, G. M. Sverdlin and Yu. F. Tarasyuk (editor-in-chief); Reviewers: A. Ye. Kolesnikov, doctor of technical sciences, and V. G. Prokhorov, candidate of technical sciences; Scientific editor: V. B. Zhukov, candidate of technical sciences; Izdatel'stvo "Sudostroyeniye", 3,100 copies, 264 pages]

[Text] This book examines the basic aspects of nonlinear wave theory as applied to solving the problem of wideband directional radiation and reception in hydroacoustics. It presents the current status of questions regarding the study, design, testing and application of hydroacoustic apparatus with parametric and optothermoacoustic arrays.

This book is intended for researchers and engineers engaged in the development, testing and operation of hydroacoustic apparatus as well as for undergraduate and postgraduate students in the corresponding fields.

Foreword

Nonlinear phenomena, the study of which is of interest for the solution to applied problems of modern hydroacoustics, are by their physical nature very diverse. Included among these are cavitation, sound generation, acoustic currents and a number of other phenomena, the description of which requires a consideration of the nonlinear terms in the hydrodynamic equations. Problems relating to nonlinear acoustics have attracted great attention in recent years. A typical nonlinear acoustic effect--the distortion of the profile and spectral composition of signals--stems from the violation of the principle of wave superposition, a principle common for all linear problems.

Nonlinear wave effects are observed during the propagation of blast waves in the ocean. There is, however, a certain difference between the blast itself and the signals which excite the electromechanical transducers. If the acoustic signals possess well-controlled parameters and make it possible to carry out exact spectral measurements, the blast impulse signals, as a rule, are not reproduced in experiments. Measurements using blast impulse signals give low accuracy. For this reason, an increase in the intensity of waves formed by acoustic methods is a pressing problem.

The utilization of coherent acoustic signals of great intensity makes it possible not only to increase the operational range of sonar devices but also to improve the accuracy of determining the target coordinates and to enhance a number of other parameters of hydroacoustic apparatus. There appear at high radiation levels essentially new effects which did not exist in linear acoustics. Certain of these phenomena (as, for example, nonlinear attenuation and clipping of the signal level in water) are undesirable in the majority of cases; many of them, on the other hand, can be useful and can be employed in the construction of hydroacoustic devices of an essentially new type.

The results of theoretical and experimantal studies of the interactions of nonlinear waves are presented in numerous articles and are summarized in the monographs of R. T. Beyer [110], L. K. Zarembo and V. A. Krasil'nikov [26], G. A. Ostroumov [74] and O. V. Rudenko and S. I. Soluyan [80]. These studies make it possible to create a reliable base for applied research. The number of annual publications on questions associated with this subject exceeded 250 in 1977. A considerable portion of the publications is devoted to the utilization of parametric arrays and instruments in hydroacoustics.

It is all the more difficult to decipher the rising tide of information, since the researchers use various models and methods for calculation and publish the results of experiments conducted under very diverse conditions with different ranges for varying the parameters. This, to a considerable degree, stems from the complexity of the processes under investigation.

This book presents to the reader an attempt to examine from unique positions the basic aspects of nonlinear wave theory as applied to solving the problem of the wideband directional radiation and reception of hydroacoustic signals. This book also presents the current status of questions regarding the design, testing and application of a new type of hydroacoustic apparatus--nonlinear parametric devices.

This book summarizes the scientific achievements and results of studies of nonlinear parameteric receiving and radiating arrays as well as of the hydroacoustic instruments in which these arrays are employed. It presents the necessary information regarding the interactions of one-dimensional waves and the basic results of a quasi-optical approximation of the linear theory of diffraction. It gives a universal theory for parametric arrays which makes it possible to study their characteristics with a high degreee of accuracy. Analytical relationships are obtained by the authors on the basis of the solution of nonlinear equations describing the behavior of acoustic beams in approximation of quasi-optics. In certain cases, results are obtained from these solutions which are calculated within the framework of the well-known models of Westervelt and Berktay, et. al., possessing a limited area of application.

A large part of the book is allocated to questions of long-distance contactless acoustic excitation using the thermo-optic demodulation effect of powerful light radiation in the surface layer of the water.

An analysis of the various operational conditions of nonlinear hydroacoustic devices is conducted on the basis of the actual properties of the environment. A comparison is given of the theoretical and experimental data regarding spatial propagation and the frequency, amplitude and phase characteristics of parametric sources and receivers. For ease in making the engineering calculations, nomograms have been constructed which make it possible to simplify considerably the selection of the parameters for nonlinear arrays. A series of consolidated nomograms for the near, far and intermediate zones of a parametric array has been put into the appendix. Here also are given recommendations for using the nomograms as well as an example of the numerical calculation of the characteristics of a specific parametric instrument.

The book presents design features and cites the basic characteristics of domestic and foreign parametric instruments: small-scale wideband measuring radiators and receivers for tanks and test stations, precision echo sounders, parametric fish detectors, sonar devices for shelf zones, parametric devices for the transmission of broadband information on a hydroacoustic channel, parametric Doppler sonar devices and acoustic recorders, parametric geolocation devices, parametric instruments for acoustic mapping through a water layer, etc.

The foreword, conclusion and Chapter 1 were written by O. V. Rudenko and V. I. Timoshenko; Chapters 2, 4, 5, 8 and 9 by O. V. Rudenko; Chapters 3, 6, 7 and the appendix by B. K. Novikov; Chapters 10, 11 and 12 by V. I. Timoshenko.

The authors use this opportunity to thank V. A. Poyarkov, T. N. Kutsenko and L. M. Timoshenko for their help in shaping the book's manuscript.

Comments and remarks regarding the contents of this book will be gratefully received by the authors.

Contents

9512
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OPERATION OF RADIO SYSTEMS

Moscow EKSPLUATATSIYA RADIOTEKHNICHESKIKH SISTEM in Russian 1980 (signed to press 19 Mar 80) pp 2-3, 222-223

[Annotation, introduction and table of contents from book "Operation of Radio Systems", by Aleksey Yakovlevich Alekseyenko and Ivan Vladmirovich Aderikhin, Voyenizdat, 15,000 copies, 224 pages]

[Text] The bases for safe operation of complex radio systems and sets are examined in the book, and practical recommendations are made for its organization in the military, taking into consideration the requirements of ergonomics. The material is illustrated using examples of radio systems in use during aircraft testing and control.

The book is designed for military specialists engaged in the operation of radio systems and sets, and it will be useful to students of VUZs for the appropriate specialties.

INTRODUCTION

The modern-day development of the USSR armed forces is characterized by uninterrupted improvement in their technical equipment. Scientific and technical progress has prompted the appearance among the military of new equipment for information processing transmission, extraction and storage, among which are complex information-measurement radio systems and complexes (RS and RC).

To keep equipment in a high state of readiness, it is necessary not only to know it and to have mastered it completely, but also to know how to organize and carry out its use on a scientific basis. Commanders and engineers studying questions of operation should clearly imagine on what conditions and factors the successful completion of a given mission depends, and they should know how to control the change in operating conditions and in the technical state. Only strict scientific organization and execution of the entire set of measures associated with the operation of equipment will permit the tasks impending before RS&S to be performed with the prescribed efficiency.

The scientific bases for organization of operation and ways to insure a high degree of readiness of complex RS and RC in the military are offered to the reader. From unified methodological positions, typical measures associated with preparation of the equipment for use, maintenance, repair and storage are examined, methods for evaluating the influence of various operational characteristics and indexes of the quality of operation are given, with the requirements taken into consideration, and fundamental regulations for the organization of safe RS and RC operation are presented. The exposition is made using a mathematical apparatus which is accessible to commanders and engineers operating complex RS&S.

The book was written based on materials from open domestic and foreign literature, taking into consideration requirements of state standards for equipment and terminology.

CONTENTS

9194
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PRECISION STANDARD TIME SERVICES

Moscow SLUZHBA TOCHNOGO VREMENI in Russian 1977 (signed to press 9 Dec 77) pp 2-6

[Annotation, table of contents and foreword from the book "Precision Time Service" by Pavel Ivanovich Bakulin and Nikolay Sergeyevich Blinov, Izdatel'stvo "Nauka", 2,950 copies, 352 pages]

[Text] A systematic presentation of methods of precise time determination, storage and transmission is given in the book. Questions related to the determination of precise time from astronomical observations, astronomical instruments and observational methods using them are treated in the most detail.

A detailed description of the instruments is given: precise time storage devices, starting with astronomical pendulum clocks and going to atomic frequency standards of various types. Modern methods of precise time signal transmission and reception are described.

The main task of the book is to acquaint the reader with the principles of chronometry. The scientific problems related to time determination are presented more briefly, such as the study of nonuniformity in the earth's rotation, the motion of continents, tides, etc. One chapter of the book is devoted to new methods of time services: radio interferometry and lidars.

The book is intended for readers familiar with the fundamentals of astronomy and radio electronics.

Some 23 tables, 141 illustrations and 12 bibliographic citations.

Table of Contents

## Foreword to the Second Edition

The second edition offered to readers is a systematic presentation of the modern fundamentals of the theory and practice of precise time determination.

The basis for the book is the special course on "The Time Service" which has been offered for many years in the astronomy branch of the physics department of Moscow State University. The majority of the book is devoted to astronomical techniques of time determination and other problems related to this question.

A chapter has been added to the second edition in which techniques of time determination by means of radiointerferometers and lasers are treated. Sections devoted to time storage and the transmission and reception of precise time signals, as well as a number of other sections have been revised taking modern achievements into account.

The basic goal of the book is to acquaint the reader with the procedures for precise time determination, storage and transmission and with the problems of a practical and scientific nature which arise in this case.

The book is intended for readers familiar with the fundamentals of astrometry and radioelectronics. It will be useful to astronomers beginning to specialize in the field of time service (especially students and graduate students), as well as geodesicts, geophysicists as well as to everyone interested in questions of precise time determination.

The introduction and sections 1 - 28, 48 - 56 and 88 - 89 were written by P.I. Bakulin and all the remaining sections were written by N.S. Blinov.



8225
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PROBLEMS OF RADIO SIGNAL PROCESSING

Moscow TRUDY RADIOTEKHNICHESKOGO INSTITUTA AKADEMII NAUK SSSR, NO. 33: VOPROSY OBRABOTKI RADIOTEKHNICHESKIKH SIGNALOV in Russian 1978 (signed to press 11 Jan 79) pp 150-51

[Table of Contents from collection "Works of the USSR Academy of Sciences Radio Technical Institute, No. 33: Problems of Radio Signal Processing", edited by V. K. Sloka, Radiotekhnicheskiy institut AN SSSR, 250 copies, 151 pages]

[Text] Table of Contents

6900
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RADIOCOMMUNICATION CHANNELS FOR ASU TP

Moscow KANALY RADIOSVYAZI ASU TP in Russian 1980 (signed to press 14 Jul 80) pp 2-3, 104

[Annotation, foreword and table of contents from book "Radiocommunication Channels for ASU TP [Automated Systems of Control of Technological Processes]", by Anatoliy Aleksandrovich Goryachev, Izdatel'stvo "Svyaz'", 7000 copies, 104 pages]

[Text] The peculiarities in designing transmission and receiving equipment for small streams of telemetric information equal to several baud units from remote non-serviced monitored sites for ACS [automated control systems] for industrial processes of diverse designation are examined, as are design principles, basic engineering decisions, characteristics, the results of tests on the main lines of the 10-meter band (HF), the carrying capacity of which is matched to the information content of ACS information sources. The efficiency of codemes and the conditions for transmission and reception of remote measuring remote signaling and remote control signals with minimum losses of power and frequency band of communications channels for diverse purposes are determined.

For engineering and technical workers specializing in the design of ACS and information transmission systems.

## Foreword

Effective control of the national economy is impossible without using modern information transmission systems. In many branches of the national economy they are striving to make broad use of inexpensive radio communication technology for the transmission of information for diverse purposes. With the increase in the number of users transmitting information by radio channels, the load of the radio frequency spectrum grows. This results in the growth of interference, complication of radio channel equipment, increase in cost, difficulties with the electromagnetic compatibility of individual communications systems, etc.

The constantly growing demand for communication transmission over communications lines advances the task of creating radio channels with a more effective use of transmission time, frequency spectrum and radio signal power by matching the information transmission speed with the carrying capacity of the communications system.

The basic results of the research conducted by the author are set out briefly in the book, and, based on the example of the designing of equipment for transmission and reception of small streams of technical information equal to several baud units, design principles, basic engineering decisions, characteristics and test results on a radio channel in the 10-meter bandwidth (HF), the carrying capacity of which has been matched to the information content of communication sources are examined.

The author acknowledges the assistance given him during the process of preparing and writing the manuscript by Professor Doctor of Technical Science A. A. Pirogov, whose useful and well-wishing advice facilitated an improvement in the contents of the book, with deep thankfulness and sincere gratitude.

Questions on the design of low capacity radio channels are essentially dealt with for the first time in the book. Obviously not everything in it will be self-evident to the readers, and therefore the author will receive comments and suggestions, which should be sent to the following address, with gratitude: 101000, Moscow, Chistoprudnyy Blvd., 2, Izd-vo "Svyaz'".

Author

Contents

9194
CSO: 1860/1

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REFLECTOR SCANNING ANTENNAS

Moscow ZERKAL'NYYE SKANIRUYUSHCHIYE ANTENNY: TEORIYA I METODY RASCHETA in Russian 1981 pp 2, 300-302

[Annotation and table of contents from book "Reflector Scanning Antennas: Theory and Design Methods", by L. D. Bakrakh and G. K. Galimov, Izdatel'stvo "Nauka", 303 pages]

[Text] This book examines general questions of theory and presents research and design methods for various types of reflector antennas. Strict and approximate methods of calculating the directional pattern are analyzed. A large portion is devoted to design and study of such widely used antennas as parabolic and Cassegrainian antennas. However, the book's primary attention is devoted to advanced antennas: various modifications of aplanatic and spherical antennas. The dynamic programming method is used to develop methods and algorithms for synthesizing optical scanning antennas whose properties are suprior to those of known aplanatic antennas. Certain questions are examined of the construction of Cassegrainian antennas, widely used in practice. Illustrations: 252. Tables 7. Bibliography: 122 titles.

Table of Contents

9875
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SECONDARY POWER SUPPLIES FOR RADIO ELECTRONIC EQUIPMENT

Moscow ISTOCHNIKI VTORICHNOGO ELEKTROPITANIYA RADIOELEKTRONNOY APPARATURY in Russian 1981 (signed to press 20 May 81) pp 2-4, 223-224

[Annotation, foreword and table of contents from book "Secondary Power Supplies for Radio Electronic Equipment" by Eduard Mikhaylovich Romash, Izdatel'stvo "Radio i svyaz'", 60,000 copies, 224 pages]

[Excerpts]

Annotation

Information on planning and designing secondary power supplies for modern radio electronic equipment is provided. Examined is a broad class of such devices intended for powering radio electronic equipment from primary ac or dc lines. Features of the operation of semiconductor devices in modern power supplies, as well as the features of the operation of the latter at high conversion frequencies, are investigated. The book is intended for a broad class of radio amateurs.

Foreword

Developments in this country and abroad have resulted in the creation of a broad class of semiconducting converters which are unprecedented among those which have been known to present. The present book contains basic information on secondary power supplies for radio electronic equipment, as well as methods for their design and planning. The book uses the terms and definitions established by GOST 23413-79 "Secondary Power Supplies for Radio Electronic Equipment. Terms and Definitions".

According to GOST 23413-79, a secondary power supply device is that functional section of radio electronic equipment which utilizes electrical energy obtained from an electric power system or electric power source and is used to form the secondary power supply of the radio electronic equipment.

The secondary power supply source of radio electronic equipment (EPS) is a secondary power supply device of a radio electronic equipment which provides secondary power supply for autonomous devices or individual circuits in a system of radio electronic equipment.

Secondary power supply sources consist of the functional modules of the secondary power supply of radio electronic equipment which execute one or several functions, for example, rectification, stabilization, amplification, regulation, etc.

The electrical parameters of the power transistors and diodes used in EPS and their literal designations correspond to GOST 20003-74 "Transistors, Bipolar. Electrical Parameters. Terms, Definitions and Literal Designations" and GOST 20004-74 "Diodes, Semiconducting. Electrical Parameters, General. Terms, Definitions and Literal Designations".

The author expresses his thanks and sincere recognition to book reviewer Candidate of Technical Sciences L. A. Kraus and scientific editor, Candidate of Technical Sciences B. N. Ivanchuk for the large amount of work they did in reviewing and editing the book, and for a number of valuable suggestions which contributed to its improvement.

Table of Contents

6900
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SEMICONDUCTOR MULTIPLIER DIODES

Moscow POLUPROVODNIKOVYYE UMNOZHITEL'NYYE DIODY in Russian 1981 (signed to press 20 Feb 81) pp 2, 4-8, 135

[Annotation, introduction and table of contents from book "Semiconductor Multiplier Diodes", by Vladimir Iosifovich Pil'don, Izdatel'stvo "Radio i svyaz'", 5000 copies, 136 pages]

[Excerpts]

Annotation

Features of the mechanism of frequency multiplication based on a nonlinear semiconducting capacitance are presented. Physical processes occurring in a diode in the presence of large sinusoidal signals are analyzed, and the analytical relationships between the diode parameters and the electrophysical characteristics of the semiconducting material are examined.

The system of parameters and technical construction features of various subclasses of multiplier diodes are examined.

The book is intended for specialists involved in the development and application of semiconductor devices.

The book was reviewed by Candidates of Technical Sciences A. A. Vizel' and V. K. Trepakov.

Introduction

The problems put forth by the modern-day development of radio electronics include the creation of solid-state microwave oscillation sources with minimum size and weight, low power consumption and high reliability. Such sources are needed for the transmitters in airborne and ground Doppler radar installations, radio relay links for troposcatter and space communication, radio astronomical research, spectroscopy, etc. Depending upon their function, the oscillators must provide steady-state output power from a few milliwatts to tens of watts in the centimeter and millimeter wavebands, and the long-term frequency instability caused by fluctuation of the supply conditions or external factors must not exceed $10^{-8}$ - $10^{-7}$ for periods of tens of hours.

One possible way to obtain microwave oscillations is to convert the power generated at a frequency of $\omega_1$ in a relatively low-frequency range to electrical oscillation power at the harmonic $n\omega_1$ of the fundamental frequency. This is done in parametric frequency multipliers, in which the nonlinear elements are semiconducting multiplier diodes (MD). These can be used to obtain oscillations at frequencies significantly higher than that of a crystal-stabilized transistor master oscillator. Recent years have been marked by significant successes in the development of semiconducting multiplier microwave diodes and a variety of radio technical devices based upon them.

Improvement of MD power characteristics and reliability is determined to a significant extent by reducing internal losses in the nonlinear elements. Therefore, the creation of multiplier diodes capable of developing high power levels efficiently at various harmonics determines the developmental trend of this class of semiconducting devices.

Thanks to the increased power of transistorized master oscillators, the improvement of diode fabrication technology and the improvement of the design of frequency multipliers themselves, transistor-multiplier network output power has now reached several watts in the 3-cm band with low long-term instability; there is a trend toward improving the latter still further.

The development of millimeter-band MD will make it possible to create solid-state power sources in the submillimeter waveband (300-450 GHz and higher), i.e., in the frequency region in which it is difficult to generate electrical oscillations with Gunn diodes or avalanche transit time diodes because of a number of physical limitations.

Thus, the requirement for creating stable, powerful sources of electrical oscillations in the shorter-wave portion of the microwave band puts forth the problem of the further development and perfection of semiconductor MD.

The present book examines these problems, which comprise the foundation of the design and construction of semiconductor multiplier diodes.

The goal of the book is to assist device and equipment developers with practical recommendations on selecting design methods and ways of using multiplier diodes of various subclasses. The main attention of the book is devoted to the physical processes which occur during frequency multiplication, and engineering methods for calculating the parameters of multiplier diodes based on the nonlinear capacitance of p-n junctions (varactors, fast-recovery diodes and diodes using the junction fusing effect). Engineering calculation methods and technical methods examined can be used in planning other classes of semiconductor devices such as limiters, pulsed, etc.

The author is indebted to book reviewers, Candidates of Technical Sciences V. K. Trepakov and A. A. Vizel' for the helpful critical remarks they made while reading the manuscript.

Table of Contents





6900
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SQUARE-WAVE GENERATORS ON MOS ELEMENTS

Moscow GENERATORY PRYAMOUGOL'NYKH IMPUL'SOV NA MOP-ELEMENTAKH in Russian 1981 (signed to press 28 Apr 81) pp 2, 5-6, 229-230

[Annotation, excerpts from foreword and table of contents from book "Square-wave Generators on MOS Elements", by Stefan Volkov, abridged translation from Bulgarian by S. M. Smolskiy, Energoizdat, 15,000 copies, 232 pages]

[Excerpts] In this book a Bulgarian author examines pulse devices based on MOS elements. Equivalent circuits, mathematical models and very simple logic elements are described; threshold devices, univibrators and multivibrators are analyzed; and an apparatus is developed for calculating sensitivity and optimizing circuits on MOS elements. Compared to the Bulgarian edition, the author has substantially reduced the intermediate formulas and described new circuitry technology solutions.

For engineering technical personnel in the field of radio electronics, automatics and measurement technology.

Foreword

Data on the parameters and capabilities of pulse generators on MOS elements are practically absent in current literature. Circuitry solutions specific for MOS technology are few and incomplete and, in contrast to circuits with bipolar elements, their design technique has not been developed.

Pulse generators on MOS elements can be used not only in computer technology, but also in many other sectors of the economy. Their development will thus enable a rise in effectiveness of scientific research. Besides the usual advantages of MOS circuits, discussed in detail below, the necessity of developing pulse generators on them is also related to considerations of compatibility with other devices on MOS elements in order to raise the degree of their integration. The introduction of plastic chassis is resulting in a sharp reduction in the cost of general purpose MOS IC's. Besides the currently predominant technique of producing a p-type channel with a metal gate, new technologies are being used with a self-centering gate, ion implantation, silicon gates, etc. They enable a sharp increase in the operating frequency of MOS elements and reduction of threshold and supply voltages; in CMOS circuits they lower the power consumption to a minimum. All this makes MOS technology extremely promising from the practical standpoint.

The obstacles listed above must be overcome if pulse generators on MOS elements are to be widely introduced in practice. Such is the basic objective of this monograph.

This book is a systematic presentation of the main areas of pulse technology based on MOS elements. It gives practically all the known diagrams of pulse generators based on MOS elements and results of research on them, which can be used in the design and rating of generators. In all the chapters, new, more current circuitry technological solutions are proposed, for which the author has received some 30 inventor's certificates. The question is comprehensively resolved of stability of pulse generators with preservation of maximum efficiency, simplicity and a high degree of integration. New, effective stabilization methods are offered, including a simple and effective circuitry design method for obtaining MOS IC's with stable transmission characteristics. These methods can be used to create universal MOS IC's which are substantially superior to all existing series in stability and recurrence of parameters. Algorithms and programs are given to determine the sensitivity of pulse generators and optimize them, which in turn results in an increase in stability and technological reliability of the circuits.

A large part of the circuits and methods of stabilizing them described in the book can be used not only in MOS technology. The algorithms and programs for optimizing circuits and calculating their sensitivity are universal, and can be used in any field of technology.

As far as the author is aware, there is no book in the world's literature devoted to a systematic presentation of questions of pulse technology based on MOS elements. It is the task of this book to fill in gap. It also attempts to provide several new definitions and develop a new classification of pulse generators, which is a generalization of preceding experience and should promote the further development of pulse technology.

The author thanks all his colleagues for their help in performing research and writing the manuscript.

Sofia, October 1978

The book manuscript presented for translation into Russian was substantially revised compared with the Bulgarian edition. In particular, intermediate computations were left out and material dealing with machine analysis and optimization of integral inverters was shortened. The book also included new circuitry technological solutions and the results of the author's research performed recently.

Sofia, August 1980

Table of Contents

9875
CSO: 1860/15

- END -